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Departamento de Economia, Gestão e Engenharia Industrial

DIOGO NUNO MENDES TAVARES

Análise de custos na cadeia de abastecimento: o método Cost-to-Serve

Analysing costs in the supply chain: the Cost-to-Serve method

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Engenharia e Gestão Industrial, realizada sob a orientação científica do Doutor Rui Jorge Ferreira Soares Borges Lopes, Professor Auxiliar Convidado do Departamento de Economia, Gestão e Engenharia Industrial da Universidade de Aveiro e do Doutor Luís Miguel Domingues Fernandes Ferreira, Professor Auxiliar do Departamento de Economia, Gestão e Engenharia Industrial da Universidade de Aveiro.

Dedico este trabalho aos meus pais e irmão, pelo amor que me dão, pela educação que me deram, e por tudo o que me proporcionaram ao longo da vida. Pelo apoio e confiança depositados e, sobretudo, por me fazerem sentir muito feliz e amado.

o júri

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palavras-chave Gestão da cadeia de abastecimento, custos na cadeia de abastecimento, método CTS, serviço ao cliente, rentabilidade do cliente.

resumo

O presente documento aborda uma técnica de medição de custos presentes na cadeia de abastecimento, com enfoque nos custos incorridos para servir o cliente.

No ambiente atual de competitividade de negócios, o conceito de cadeia de abastecimento está a atravessar uma grande alteração, mudando no sentido de desenvolver estratégias segmentadas para o cliente com o objetivo de proporcionar maiores níveis de valor ao cliente. As estratégias para a cadeia de abastecimento têm sido predominantemente planeadas para a excelência na redução de custos associados com funções de caráter comercial.

Neste contexto, a identificação do Cost-to-Serve de clientes específicos em toda a cadeia de abastecimento é um dos desafios mais difíceis pelos quais os gestores se deparam, muito graças à diversidade de inúmeras atividades presentes na cadeia de abastecimento. Os mercados estão cada vez mais orientados para o cliente e as organizações estão a focar a sua atenção no sentido de melhorar o atendimento global deste.

Desta forma, os modelos de medição de custos devem ser concebidos de maneira a identificar e abordar a forma como os custos de servir o cliente afetam as estruturas de custo das empresas, assim como compreender a rentabilidade individual dos clientes, especialmente para empresas baseadas em serviços.

A principal vantagem de uma análise CTS reside na forma de como a informação obtida pode ser utilizada para fazer ajustes apropriados a políticas e processos de serviço, especialmente para com os clientes que geram uma rentabilidade negativa, assim como as suas respetivas margens de contribuição e a reconfiguração das funções de marketing e negócios de caráter logístico.

keywords Supply chain management, supply chain costs, CTS method, customer service, customer profitability.

abstract

Current document addresses a technique for measuring costs present in a supply chain, with a special focus on the costs incurred to serve the clients.
In today's competitive business environment, the supply chain concept is experiencing a major change, shifting towards developing customer-segmented strategies with the aim of providing higher levels of customer value. Supply chain strategies are being planned predominantly for excellence in cost reduction associated with business functions.
In this context, identifying the Cost-to-Serve of specific customers across the supply chain is one of the most challenging problems by which managers have to deal, mostly due to the diversity of numerous activities present in any supply chain. Markets are increasingly becoming customer oriented and organizations are driving their attention to improve overall customer service.
Therefore, cost measurement models have to be designed in order to identify and address how customer service costs affect the cost structures of companies, as well as to understand individual customer profitability, especially those companies focused on services.
The main benefit of a Cost-to-Serve analysis lies in how this kind of information can be used to make appropriate adjustments to policies and service processes, especially to loss-making customers, as well as their respective share of contribution margin, and the reconfiguration of marketing functions and logistics business.

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3PL	–	Third-party logistics
ABC	–	Activity-based Costing
ABM	–	Activity-based Management
CP	–	Customer profitability
CTS	–	Cost-to-Serve
DSS	–	Decision support system
JIT	–	Just-in-time
ROI	–	Return on investment
SCC	–	Supply chain cost
SCM	–	Supply chain management
SKU	–	Stock keeping unit
TCAS	–	Traditional cost accounting system
TSCC	–	Total supply chain cost

1. Introduction

In an ever increasingly competitive environment, the level of demand for the development of more efficient management systems as a means to achieve high levels of competitive advantage is also increasing. In order to compete in highly unpredictable markets, companies need to adopt appropriate strategies, aiming at creating value out of their main business functions to guaranty high levels of customer service. The worldwide competition is driving companies to find alternatives to improve their supply chain concepts, shifting towards developing customer-segmented strategies to achieve higher levels of customer value. The reason for this shift regards to customer demand of lowering prices and offering superior quality products while, at the same time, companies strive to increase service quality and reduce service costs.

Nowadays industrial environments require companies to reduce their supply chain costs for several reasons. Supply chain strategies are being planned predominantly for excellence in cost reduction when performing daily activities, through the use of specific techniques that can effectively disclose the true nature of costs. Traditional cost accounting systems (TCAS) evidence some difficulty or inability to identify the costs incurred with serving customers since their main purpose is to capture the nature of product costing and operational control. Companies are concentrating on ways to best identify their cost drivers and improve their profits, and for that reason, they require appropriate costing systems to identify the real costs incurred when satisfying customer demand through supply chain processes.

In this context, the identification of the costs to serve specific customers across the supply chain is one of the most challenging problems by which managers have to deal, mostly due to the diversity of numerous activities present in any supply chain. Markets are increasingly becoming customer oriented and organizations are driving their attention to improve overall customer service. Therefore, cost measurement models have to be designed in order to identify and address how customer service costs affect the cost structures of companies, as well as to understand the profitability of individual customers, products and service activities (Braithwaite & Samakh, 1998). In response to this new paradigm, a costing system is proposed to address this challenge, called the Cost-to-Serve (CTS) method, where its main

features are identified with a practical example of its application to ascertain its main potential. Unlike many new techniques, it does not try to substitute old ways of working, but rather by attempting to overlay new insights while enabling the established organization to integrate.

1.1. Objectives

This dissertation is presented in partial fulfillment of the requirements for the Master's degree in Industrial Engineering and Management at the University of Aveiro. The object of study focuses on a recent topic in current literature regarding the supply chain costing concept, still underdeveloped but, nevertheless, with a huge margin of growth in the upcoming years.

The main objective of this research is to study the application of the CTS method to measure the costs incurred with supply chain activities that are necessary to answer customer needs of products and services. The goal is to identify the true costs present in a customer-service type supply chain, with an emphasis on logistics activities, to provide companies with more appropriate decision-making tools based on more accurate costing information. The CTS method can assign costs to products, activities, services, and customers, in order to measure profitability and provide economic feedback and timely information to managers better than traditional accounting systems.

In this research, it is intended to explain the CTS method as a tool for the management of costs in service companies through a concise literature review. Furthermore, in order to analyze the applicability of the CTS methodology, basic elements are studied in detail to understand the contents that are generated as a result of the CTS analysis, with a special focus on the determination of Customer Profitability (CP) levels. To better illustrate the applicability of the method, a framework is proposed to illustrate the first steps of the CTS method. This framework provides the initial insights into how activities are identified and analyzed in order to assess the costs belonging to each activity that is necessary to answer customer demand. In this regard, this research study sought to answer the following two main questions:

- What are the main benefits of applying the CTS method as a means to uncover the costs of specific activities, products, and customers in order to support managers with strategic decision-making? and
- How can a CP analysis provide positive and negative financial contribution to the company by analyzing specific customers, products, and activities? What can be achieved by assessing the margins after CTS for each combination of customer-product-activity?

1.2. Structure

Current dissertation is structured with five main chapters.

In the first chapter, the goal of the research is presented and its main features. This chapter describes the current industrial context that organizations face and the motives that led to the development of such research in the area of supply chain costs. The chapter includes a brief introduction to the topic, a description of the main objectives to fulfill, and the structure of the dissertation.

The second chapter intends to review current literature with the purpose to frame the topic to the global study and to contextualize the study with theoretical foundation. The chapter describes all theoretical concepts that are present in the research and how its contents are related to the main objectives of this dissertation. The most significant topics analyzed in this chapter relate to the concept of supply chain driven by customer needs and the concept of supply chain cost (SCC). To sum up, the chapter also presents the CP classification technique to assess the profitability values from different customers.

The third chapter starts with an approach to the Activity-based Costing (ABC) method. This step is due to present the current state of actual cost measurement methods and the characteristics of the ABC methodology. Then, the main aspects of the CTS method are explained in detail, as well as the variables necessary to its application as inputs, how the application is performed and calculated, and an assessment of the expected outputs. Furthermore, the CTS method is used for comparison with the ABC method in order to identify the major differences between each other. The goal is to justify the adoption of the CTS method in detriment to the ABC method.

The chapter also introduces the allocation of costs following specific rules. To finalize, the application of the case study is demonstrated, providing the outcomes and benefits from such an analysis.

The fourth chapter intends to provide a general framework for the CTS method. It starts by explaining how costs are determined following a set of rules. Then, an introduction to how activities are identified is provided with the associated costs that drive activities. To finalize, a framework is developed to illustrate this process, where the main elements that define the major activity groups are defined.

The last fifth chapter discusses the main aspects of the research performed, its most critical conclusions and its limitations. Several other new opportunities for future research are proposed as potential elements related to this dissertation.

2. Supply chain management and costs

Although the concept of Supply Chain Management (SCM) is being more often debated and given prominence in recent years, it has been in existence for a very long time. SCM is not a new term and discussions about SCM often end up with a mixture of terminologies, limiting the comprehension of its phenomena (concept and effectiveness for practical application) (Frazelle, 2002). SCM can be described as the management of interconnected businesses and individual contributors involved in creating a product, from raw materials to finished merchandise, to answer the end customer's requirements and needs (Christopher, 2011; Handfield & Nichols, 1999; Harrison & Hoek, 2008; Mentzer et al., 2001; Shapiro, 2007). It encompasses every process and activity associated with the flow and transformation of goods, as well as the information necessary to perform every step, from its first stage, through the whole supply chain, until it reaches the final customer. Both material and information flow up and down the supply chain, where every entity performs a specific activity. Christopher (2011) defines supply chain as the management of upstream and downstream relationships with suppliers and customers, it suggests a series of processes linked together to form a network of organizations, in order to deliver superior customer value at less cost to the supply chain as a whole. It consists of several independent entities, both upstream and downstream, with the common goal of efficiently and effectively manage all entities and operations in the supply chain.

The supply chain implies a series of processes and elements linked together to form a chain of activities. It is basically composed by suppliers, manufacturing entities, raw material and component producers, warehousing activities, distribution centers, transportation activities, inventory and information management, finished goods, wholesalers, retailer merchants, customers and other related management activities. These are all pieces of a bigger puzzle that shape the supply chain, including the final consumer as part of it. For Mentzer et al. (2001) SCM is broadly defined as a systematic, strategic coordination of traditional business functions and tactics across these business functions within a particular company and across businesses within the supply chain. Consisting of firms working together to leverage strategic positioning and to improve operating efficiency, for the purposes of improving the

long-term performance of the individual companies and the supply chain as a whole, as well as to enhance organizational productivity and profitability.

In general, SCM encompasses a group of interconnected activities involved in sourcing and procurement, conversion and transformation, and all logistics management activities. Therefore, it requires coordination and collaboration with channel partners, which can be any entity in the supply chain, such as suppliers, intermediaries, third-party service providers, and customers. Moreover, many activities that in the past were performed internally with a high degree of secrecy are now interlinked and span the traditional boundaries of organizations. In consequence organizations seek to develop strategies to facilitate and protect information sharing between trading partners, from the very beginning of the supply chain to the end customer (Christopher, 2011). Figure 1 is an example of a supply chain network with a network of suppliers and customers with a main firm at the center with many possible connections with other entities. The activities are cross-linked to one another, from firm to firm, creating a network of inter-dependent processes and relationships which require the management of an extended enterprise. The upstream and downstream arrows indicate the direction of both materials and information flow. Supply chain involves coordinating and integrating these flows between all firms involved in it. This supply chain presents a number of processes that extend across organizational boundaries where the focal firm in the center is embedded within it and its operational processes have to be coordinated with others of the same chain.

In this regard, the supply chain may be comprised of an arbitrary number of entities. Downstream of the focal firm there are distributors and final consumers such as wholesalers and retailers. Upstream the focal firm there are manufacturers, assemblers and raw materials suppliers. Moreover, it is possible that products may flow upstream as intermediate products are returned to plants for re-work, or re-usable products are returned from markets to distribution centers for re-cycling (Shapiro, 2007). Information sharing plays a major role at this level of connectivity between firms in the supply chain. Some activities might originate differences regarding the strategy adopted by many partners in the supply chain. However, this may constitute impasse situations when firms are planning and coordinating their own objectives with the needs of the whole system.

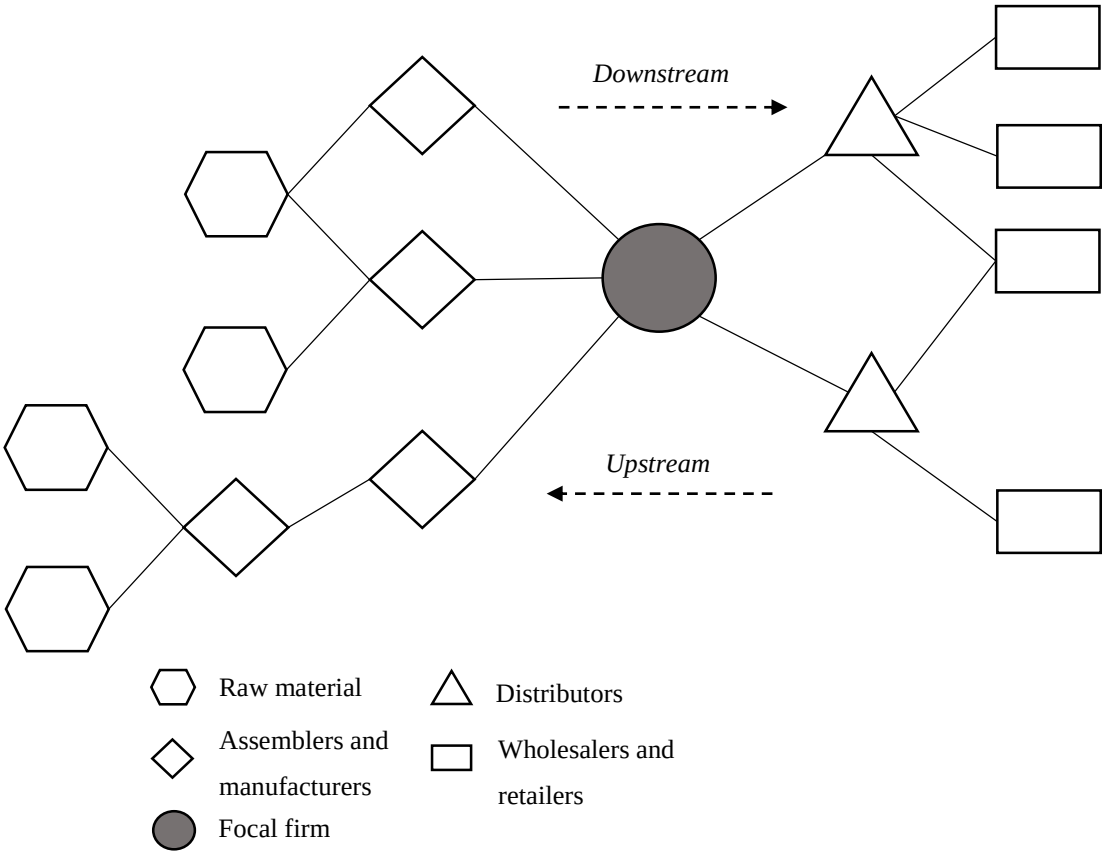

Figure 1: Example of a supply chain network (adapted from Christopher, 2011).

The supply chain from a strategic perspective deals with many components. Cohen and Roussel (2005) provide indicate several critical components that prompt the supply chain towards effective strategies to achieve competitive advantage. The authors state that the supply chain is defined by combining the following five main components:

1. operations strategy
2. outsourcing strategy
3. channel strategy
4. customer service strategy
5. asset network

These interdependent components should be addressed in conjunction with supply chain partners as an integrated whole in order to achieve competitive advantage. For these authors,

the configuration components are fundamental building blocks of a supply chain strategy to achieve overall business objectives. Usually, the aspects that affect the components of a supply chain are concerned with:

- alignment of business strategy
- alignment of customers' needs
- alignment of power position (influence)
- adaptation due to unstable market conditions

Each supply chain should align its strategies according to its business activities and focus on developing competitive advantage through increasing business value. All of the previously described criteria provides insight into how strategies should be composed to create value. However, in order for a supply chain to successfully address every strategy developed by every firm, an integration of these components must be accomplished. Mentzer et al. (2001) argue that a tight coordination across companies and across functions in the supply chain is needed. Both coordinate marketing, sales, research and development, forecasting, purchasing, logistics, information systems, finance and customer service. For these authors the ultimate goal is to manage and accomplish a set of supply chain flows, all the way from suppliers to end-customers, in order to acquire their satisfaction who represent the ultimate customer. A key success feature towards supply chain transparency lies in the integration of every activity and processes that are part of the supply chain network. In this regard, Huber and Sweeney (2007) describe the SCM as being composed by the following supply chain activities:

- customer service
- sales order processing
- procurement & purchasing
- production planning and control
- after sales service
- customer relationship management
- outbound transport
- inventory management
- warehousing
- inbound transport

- new product introduction
- demand forecasting

According to Shapiro (2007) an integrated supply chain planning is initially concerned with the functional integration of activities such as purchasing, manufacturing, transportation and warehousing activities. He also refers to the spatial integration of these activities across geographically dispersed vendors, facilities, and markets. To finalize, the author indicates the inter-temporal integration or hierarchical planning of these activities over strategic, tactical and operational planning levels, which requires consistency and coherence among overlapping supply chain decisions at the various levels of planning. The strategic planning level refers to those decisions made on a long-term period, involving resource acquisition decisions. On the tactical planning level decisions are made on a medium-term period, involving resource allocation decisions. At last, on an operational planning level the SCM is concerned with the short-term decisions affecting the daily execution of the company's business. The integration of these activities through improved supply chain relationships is a key component to achieve competitive advantage. Hence, both materials and information flows and the management of relationships must be combined to achieve a successful SCM.

Every partner in the supply chain must be committed to the principles of the overall system and being able to make decisions that encompass every entity. The main basis of integrating supply chains can be characterized by the cooperation and collaboration, trust, information sharing and partnerships between firms. The end result is an integrated chain of processes with the synchronization of supply chain activities to create customer value and satisfaction, increasing the efficiency of the whole system. For Mentzer et al. (2001) various standard practices are necessary to successfully manage a supply chain. These set of practices constitute an integrated behavior of all entities in a supply chain, mutually sharing information, mutually sharing risks and rewards, cooperation, the same focus with the same goal on serving customers, integration of the supply chain processes, and finally partnerships to maintain long-term relationships. This set of activities represent the necessary efforts to coordinate the SCM between supply chain partners to dynamically answer the needs of the end customers.

The trend on partnerships based on core competencies is shaping the new markets making the integration of supply chains a requirement. Handfield and Nichols (2002) give three

major examples of developments in global markets and technologies that brought SCM to the forefront of executive management's attention, which are:

- Ever-increasing customer demands in areas of product and service cost, quality, delivery, technology, and cycle time brought about by global competition.
- The emergence of and greater acceptance of higher-order cooperative interorganizational relationships.
- The age of information revolution.

These three developments are in fact growing trends being adopted by firms towards the interpretation of current global market strategies. Customer retention through satisfying customer needs is turning to be a critical factor to continue competitive in markets where offer is continuously increasing. Therefore, an effective approach to identify customer needs is a major step for success. It is in the supply chain that customer-focus efforts are strategically planned between partners. These trends are important for an integrated supply chain to create a valuable system capable of delivering value to end costumers and achieve customer satisfaction, while effectively exploiting the competencies of all organizations involved. The goal of an integrated supply chain strategy is to create manufacturing processes and logistics functions, seamlessly across the supply chain, to develop competitive advantage, and to avoid duplication from competitors (Tan, 2001). Nevertheless, it is understood that competitive advantage is acquired, from a SCM perspective, as a consequence of a firms' efforts by creating customer value and satisfaction, which in turn aims to establish a profitable and sustainable position against direct competitors. As a consequence all members of a supply chain are able to obtain improved profitability and are able to manage more efficient ways to maintain or improve the level of customer service.

2.1. Supply chain and logistics activities

Supply chain management can be described using different perspectives and according to its concept evolution. Tan (2001) describe two distinctive classifications, which are the purchasing and supply chain perspective, and the transportation and logistics perspective. Christopher (2011) emphasizes that the concept of SCM, while relatively new, is an extension of the logic of logistics or by other words, an integrated logistics system. Logistics

can be seen as a broader framework of the SCM. The primary focus of SCM is concerned with the creation of highly efficient physical distribution channels from manufacturers to end users, in an attempt to replace inventories with information. Whereas logistics is concerned with the transformation of products, from entity to entity in the network. In contrast to SCM, logistics is the required effort to move and position inventory throughout a supply chain. Logistics is the process that creates value by timing and positioning inventory. It represents the combination of a firm's several activities such as order management, inventory, transportation, warehousing, materials handling, and packaging as integrated throughout a facility network (Bowersox, Closs, & Cooper, 2002). Logistics is composed of three main factors that structure the supply chain network. They are the flow of materials, the flow of information and the time taken to respond to demand from the source of supply, which is however a key part of the overall task of SCM. The flow of goods, services, and related information between the supply chain entities must be quick and orchestrated to avoid build-ups of inventory (Harrison & Hoek, 2008). At this stage the synchronization of activities and processes is a major challenge which requires a lot of effort to be successful. Piles of stock in the supply chain are responsible for high costs that are expendable since the main goal is to bring these goods from the point of origin to the point of consumption in order to meet customer's requirements. Christopher (2011) says that the scope of logistics depicts the flow of materials from the first state to the final product, Figure 2 exemplifies the logistics management process. Moreover, Eloranta and Hameri (1991) propose that logistics tend to be separated into inbound and outbound logistics. Where inbound logistics refers to the movement of materials through the supply chain that are received by a business and outbound logistics refers to the movement of goods through the supply chain that are dispatched by a business. For Christopher (2011) logistics management is the process where customer needs are satisfied through the co-ordination of materials and information flows that extend from the marketplace, through organization boundaries and its operations and beyond that to suppliers.

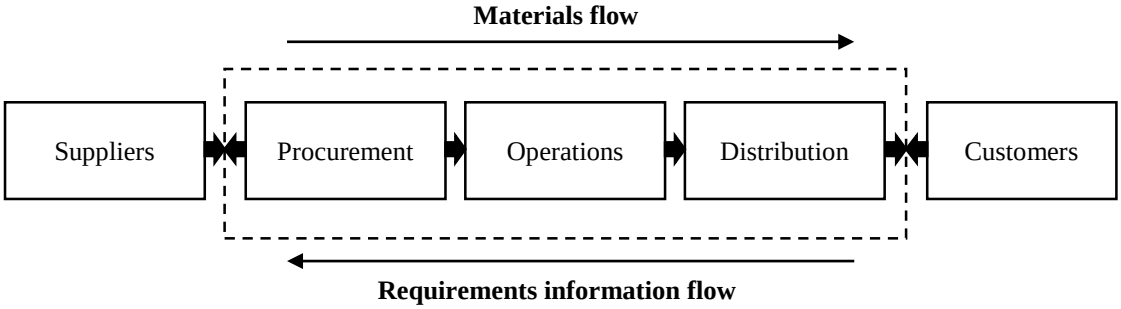

Figure 2: Logistics management process (Christopher, 2011).

The physical flow of materials represent the inbound logistics where procurement, operations and distribution are main activities of this process. For Weil and Maher (2005) inbound logistics includes the costs of people and assets required for a set of sub-activities like moving and storing material through the various stages of transformation. The information flow is often related to the outbound logistics, representing demand management, order processing and also materials management. The activities related to information flow are responsible for production orders and materials requirements including many sub-activities like cost of transactions, planning, and change control.

The integration of supply chain is the means to achieve competitive advantage and logistics management has the task to coordinate material and information flow across the supply chain by meeting end-customer demand through supplying what is needed, when it is needed and at low cost. Therefore, as stated by Harrison and Hoek (2008), in order to define logistics advantage one must first distinguish three objectives such as quality, time and cost. Other ways to create logistics advantage are controlling variability in logistics processes and dealing with uncertainty. In this scheme of variants there are several aspects that must be measured and quantified in a system-wide perspective. The correct flow of goods and information depend on how the planning of logistics activities are made with other business functions, such as distribution, marketing, warehousing, administration, manufacturing and procurement.

With the emergence of global marketplaces, global logistics companies are acting more and more as system integrators for corporate clients, it is becoming a common process to outsource logistics activities to second or third party providers. By doing so organizations

are able to focus on their core competencies and cut costs associated to logistic activities. Ross, Jayaraman, and Robinson (2007) state that third-party logistics (3PL) providers establish real-time communications between costumers, major carriers, and terminals to manage equipment, suppliers, and facilities efficiently and to smooth the peaks and valleys in demand and availability. By outsourcing logistics activities, information sharing becomes a crucial step to achieve cross-functional and cross-enterprise integration. It is thus necessary to eliminate or at least reduce any communication barriers between possible participants in the logistics and supply chain. Making the information sharing transparent to all players, by transferring it between companies, will not only provide a clear visibility of the flow of materials and information through upstream and downstream, but also provide the possibility to manage operations more efficiently and in accordance to real-time information. It is important to have the correct feedback from operations to support the management at the level of decision-making.

2.1.1. Supply chain and customer orientation

One big challenge organizations need to address is the volatility of customer demand. Supply chains with a customer focus are experiencing major shifts on how customer value is linked with supply chain strategies. Traditional supply chains are designed in a way that supplying companies are the starting point of a chain of processes that flow all the way to customers. This approach is interesting from the manufacturers' perspective, since their needs are given more prominence, and clearly didn't benefit the end customer needs. However, this approach is becoming less and less appropriate due to demand volatility. According to Christopher and Towill (2001) supply chain performance can be improved by matching supply to demand and thereby driving down costs while simultaneously improve customer satisfaction. Therefore, supply chains are now being designed reversely where the consumer is the starting point of supply chains and not the end as it used to be. This new perspective is often referred to 'demand chain management' with the purpose to effectively meet different customer needs (Jüttner, Christopher, & Baker, 2007). In order to understand the value that customers seek and identify a real market segmentation, Christopher (2011) suggests an appropriate sequence of actions to create a market-driven supply chain. The actions include

1. an identification of value segments;
2. a definition of value propositions;

3. an identification of market winners; and
4. the development of supply chain strategy.

According to Thomas (2012) supply chain segmentation is a process by which organizations can develop profitable one-to-one relationships between customers and supply chains where different customers associated with different channels and different products are answered through different supply chain processes, policies, and operational modes. Firms composed of supply chains with high levels of complexity tend to separate business units to better control business objectives. The complexity is a result of innumerous product lines, customers, suppliers, distribution channels, and so on. By segmenting supply chains according to business units, it is possible to optimize any part of the supply chain and gain substantial efficiencies. It is clear that an important goal is to identify the best strategy to serve each customer at a given point in time while also maximizing both customer service and profitability. In doing so, Christopher (2011) states that customers' service needs have to be identified through a service segmentation criteria, which follows a three-step process:

1. Identify the key components of customer service.
2. Establish the relative importance of those service components.
3. Identify groups of customers according to similarity of service preferences.

According to Christopher (2011), the first step is to research which are the most prominent indicators or sources of influence by which customers address the purchase decision-making. Once these elements affecting decision-making are defined one can identify the relative importance of each one and target customers more appropriately. The second step deals with how customers rank order the importance of separate elements affecting costumer service among different customer groups. The final step is to analyze if there are any preference similarities between respondents. Furthermore, if any distinct set of priorities emerge from the assessment it would be necessary to create different service segments for each customer group. The main goal is to create appropriate supply chain solutions to meet the needs of different value segments and better match supply chain strategies with customer requirements. If organizations successfully develop segmentation strategies it is more likely that customer service will improve while increasing the profitability of a specific business.

Furthermore, Braithwaite and Samakh (1998) explain that current markets are very competitive reflecting the norm of customers' utility and expectations. The creation of

innovative solutions in terms of both product and service can drive up competitive advantage. Currently, product and market half-lives are getting shorter as markets become more global through communications, among other things. Therefore, Hamel and Prahalad (1996) argue that current supply chain strategies tend to focus on homogeneous product and market segments. The idea that any company can operate on a full-range, full-service vendor is dwindling and somehow reflects an attempt to balance cost and service for the business as a whole. For Braithwaite and Samakh (1998), the premise behind being competitive in global markets is not about riding a trade-off curve, but rather being able to change the shape of the curve. In that regard, the authors present the following supply chain principles:

- If a company can compress its lead-times, raise quality and accuracy at every stage, service will improve and cost will fall out of the business.
- Organizations should take a process view rather than a functional view of operations.
- Working across functional boundaries to integrate business processes is the future, organizations must learn how to integrate themselves across the supply chain.

By matching these principles, the authors defend that any organization can achieve competitive advantage, especially during the period of time until the competitive paradigm isn't changed. Not to mention that business practices will eventually be easier to manage due to adopting appropriate supply chain strategies. However, it is important to note that the integration of supply chain practices is a fundamental requirement for any of these principles to become a reality.

2.2. Supply chain cost extension

In today's competitive business environment, alongside with the evolution of the supply chain concept, reducing costs associated with business functions is becoming an important driver of competitive advantage and sustainability (Christopher, 2011). Increasingly, organizations choose to focus on reducing costs when performing daily activities, usually the ones with highest labor content and resource consumption. However, companies need to know how to correctly identify these costs in order to proceed with cost measurements. Measuring costs is essential to determine organizational performance. Supply chain cost (SCC) refers to all relevant costs present across any supply chain of every organization, not

only the ones originated from material and information flows, but also due to the relationships within it. The integration of supply chains is experiencing a process-oriented, integrated approach to procuring, producing, and delivering products and services to customers (Amit, Sahay, & Dinesh, 2005). It is apparent that nowadays people are giving more attention to the benefits when acquiring a specific product rather than just the natural functionality of a product. These benefits have the purpose to deliver significant customer value in order to prompt customers ending up choosing a specific product. The process that brings value to customer is in part related to distribution service since this functional area makes it possible to deliver a set of features in order to meet customer needs. Some of the customer service and logistics activity value-add attributes are related to delivery lead time, flexibility, reliability, consistency, order fill, customer support, etc. According to Christopher (2011), the main objective of customer service is to provide customers with the right level and quality of service, and to do so, at less cost to the whole supply chain.

Furthermore, it is important that costs are measured properly to identify which services and customers are profitable in order to develop strategic measures to oppose any negative scenario. However, one must realize that there are costs as well as benefits in providing customer service. The appropriate level and mix of service provided should vary substantially from customer to customer, especially by taking into account the importance that a specific customer has on the overall business activity. Thus, the design and development of a decision-support framework for the identification of all costs incurred when serving customers is of utmost importance to take a proactive approach to holistic expense management and to measure the profitability of each business partner. The application of world-class cost service measurements is a requisite to achieve world-class service performance (Frazelle, 2002). From this approach it is possible that even new opportunities might arise since SCC measurement should be treated as an ongoing exercise, regardless of any functional condition.

There are many ways to approach SCC measurement. A concise view of cost groupings is given by Pettersson and Segerstedt (2012).They suggest that SCC can be divided into five main areas plus a sixth if applicable for supply chains where installation costs belong to the business structure. Costing areas often vary from supply chain to supply chain, depending on the type of dominant activities and according to the nature of business. Hence, the following main cost areas are:

1. manufacturing cost
2. administration cost
3. warehouse cost
4. distribution cost
5. capital cost
6. installation cost

The total supply chain cost (TSCC) in a company is simply the sum of all costs for all areas. For some supply chains manufacturing cost is the most dominant part but, however, for service specific supply chains distribution cost is definitely the most relevant. By dividing SCC into groups one can clearly see where in the supply chain costs originate. These costing areas can only be perceived as a base standard for further measurements, since it depends on a company's supply chain and the nature of business activities. Christopher (2011) presents a concept that demonstrates the relationship between customer service goals of a given supply chain within a specific product/market context and the resulting costs associated with the accomplishment of these goals for every functional area. Figure 3 illustrates this concept by identifying the points where the interceptions occur between the relationships. One can acknowledge that specific customer service goals of a given supply chain will mainly have an impact on purchasing, production, sales, marketing, transportation, etc. From the impact of the interceptions between the supply chain goals and the functional areas results a set of costs associated to every activity responsible to meet the expected customer service.

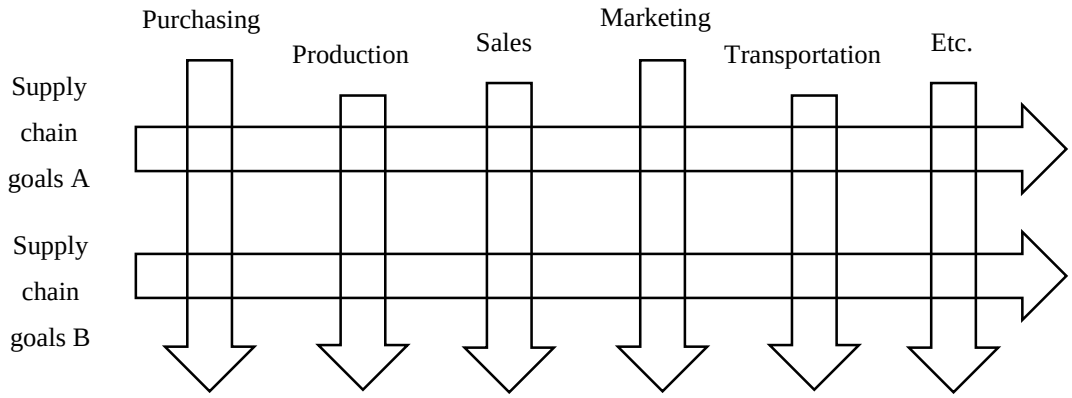

Figure 3: Functional boundaries (adapted from Christopher, 2011).

It is clear that an effective costing system approach must be capable of determining the total system cost by identifying all costs present in all activities that are responsible for achieving the desired customer service goals. For Cohen and Roussel (2005), a performance measurement of these relationships and the costs associated with these activities are the only way to understand whether a process performance is improving or worsening and whether an action is actually needed. For the authors, a performance measurement is about putting in place the right metrics to assess the state of a supply chain.

According to Christopher (2011), the purpose of SCM and logistics is to provide customers with the right level and quality of service that they require while doing at the least possible cost. Hence, one must first distinguish SCC and logistics cost. Pettersson and Segerstedt (2012) briefly explain that logistics cost is usually associated with distribution costs, transportation costs, and costs for warehouses. The logistics functions often deal with product as it is extracted, transformed, manufactured, assembled, configured, delivered, installed and used (Freeman, Haasz, Lizzola, & Seiersen, 2000). At all stages of logistics functions expenses are usually associated with indispensable activities which represent big costs and ties up a lot of assets. On the other hand, SCC regards to order handling costs, purchasing costs, stock handling costs, marketing costs, sales, and many more. Since SCM is a wider concept of logistics, the same applies to SCC and logistics cost. SCC is defined more broadly and contains logistics cost. Usually conventional cost accounting systems are used to estimate costs but rather being recommended, it is not entirely accepted by many authors in literature.

Christopher (2011) argues that conventional cost accounting systems offer great difficulties in measuring SCC since it groups costs into broad aggregated categories prejudicing further analysis that are essentially to identify the real costs of serving customers. He summarizes the problems in the following way:

- The true costs of servicing different customer types, channels and market segments are poorly understood.
- Costs are captured at too high a level of aggregation.
- Full cost allocation still reigns supreme.

- Conventional accounting systems are functional in their orientation rather than output oriented.
- Companies understand product costs but not customer costs.

To overcome this problem it is necessary to create cost accounting systems capable of identifying the origin of actual costs. Traditional systems need to be adapted for different situations with a focus on services. Instead of viewing the market as a uniform group of customers with similar characteristics, the segmentation of the group by examining each customer as containing different intentions could definitely potentiate the assessment of the true nature of costs. Similarly Braithwaite and Samakh (1998) affirm that traditional cost-determination systems do not allow accurate analysis of individual customer performance, especially when the company in case has a wide range of products and customers. Simply because the system cannot identify the relevant differentiating factors that determine the levels of profitability of particular distribution channels. Again Christopher (2011) explains that the basis of cost accounting needs to be radically changed away from the notion that all expenses have to be allocated to individual units (such as products) and, instead, to separate the expenses and match them to the activities that consume the resources. Christopher (1998) also describes two principles for logistics costing:

- The system should reflect the flow of materials. It should be capable of identifying the costs that result from providing customer service in the marketplace.
- The system should be capable of making cost and revenue analysis for customer types, market segments and distribution channels.

Once SCCs are identified, management is capable of effectively enhance the performance of the overall SCM with the cooperation of supply chain partners. The measurement of SCC has to be as accurate as possible to support managers taking decisions. Otherwise during the measurement processes the data being analyzed could be deceitful and might jeopardize the entire process. Kaplan and Cooper (1998) state that management can use cost knowledge to focus on the most important products and customers to increase customer service and profitability. They state that organizations need cost systems to perform a set of three primary functions:

- Valuation of inventory and measurement of the cost of goods sold for financial reporting.

- Estimation of the costs of activities, products, services, and customers.
- Providing economic feedback to managers and operators about process efficiency.

The first function is external to organizations, driven by a series of imposed financial rules and regulations. The second and third functions are part of internal organizations. Management require accurate and timely cost information to improve efficiency by identifying and eliminating non-value operations in the supply chain processes. Even though it may be difficult to acquire the true costs of operations for many organizations, mostly because the supply chain processes transcend both functional and company boundaries, it is necessary that members of a supply chain develop collaborative actions to better allocate tasks and related costs among channel members. Norek and Pohlen (2001) state that partners in the supply chain are able to achieve greater success by collaborating and sharing cost information in order to reduce costs. To lowering total costs or achieve a desired level of customer service one must first identify which specific factors need to be analyzed and adjusted. Furthermore, a set of cost and performance metrics must be implemented in order to determine the consequences of the joint improvement efforts across the supply chain. Kaplan and Cooper (1998) argue that current environment demands more relevant cost and performance information on the basis of organization's activities, processes, products, services, and customers. The authors affirm that companies are using their enhanced cost systems to:

- Design products and services that both meet customers' expectations and can be produced and delivered at a profit.
- Signal where either continuous or discontinuous (reengineering) improvements in quality, efficiency, and speed are needed.
- Assist front-line employees in their learning and continuous improvement activities
- Guide product mix and investment decisions.
- Choose among alternative suppliers.
- Negotiate about price, product features, quality, delivery, and service with customers.

Previous measures are just some examples of what can be achieved once costs are measured and plans are adopted to minimize total costs. Channel members need to analyze the costs for incurring business with specific customers or suppliers to ensure the competitiveness of

supply chain. Firms can increase profitability by concentrating their efforts in improving the relationships with their current profitable customers. Norek and Pohlen (2001) point that management can use the resulting cost knowledge to revise business practices with less profitable accounts to reduce losses or increase margins. Guerreiro, Bio, and Merschmann (2008) state that conventional wisdom in the cost accounting literature recommends the elimination of loss-making accounts. However, one must realize that usually a significant proportion of service-activity costs are fixed costs. By eliminating loss-making accounts thus eliminates the contribution that these customers provide to the company, without necessarily eliminating the corresponding fixed costs. A solution concerns the simulation of optimal models to identify which type of supply chain strategies should be adopted so that all partners in the supply chain can benefit from it (Amit et al., 2005). The main goal when developing a supply chain model is to minimize the TSCC under different scenarios, such as the best case or worst case scenarios, to devise policies according to every specific case.

According to a research performed by Hoole (2005), TSCC can vary by 5 to 6 per cent of annual revenues between companies in the same industrial sector, based on a benchmarking of more than 500 supply chains. Likewise Harrison and Hoek (2008) explain that studies regarding customer buying behavior have shown that cutting out non-value-added products and inefficient promotional activity can reduce overall costs by 6 per cent. Pettersson and Segerstedt (2012) conducted a survey among 30 Swedish companies, active in 10 different industrial sectors, to discover if they were measuring the actual costs present in their supply chains. They concluded that 22 companies were measuring some of the SCC components and even use accurate cost information, only 1 company measures all parts of the SCC. Huber and Sweeney (2007) performed a study among 776 Irish firms to gain unique insights into current levels of awareness/adoption of key practices to control SCCs and their potential impact on supply chain competitiveness. They found out that 59 per cent of companies do not know their TSCC. By not constantly tracking down costs one cannot effectively measure the costs incurred when serving customers, which may eventually result in financial losses, and, thereby, wasting good opportunities to improve supply chain performance.

A strategy to increase net income, is based on minimizing total costs by cutting them, leading to greater earning per share and ultimately a higher market value (Kumar & Chang, 2007). Similarly Shapiro (2007) says that when measuring net revenues, assuming that gross revenues from demand are fixed and given, the only way to maximize net revenues is by

minimizing total costs. He enumerates total costs as being comprised of a number of terms including

- raw material and other acquisition costs;
- in-bound transportation costs;
- facility investment costs;
- direct and indirect manufacturing costs;
- direct and indirect distribution center costs;
- inventory holding costs;
- inter-facility transportation costs; and
- out-bound transportation costs.

However, it is not necessarily true that every company possess all these type of costs. It may vary from firm to firm depending on its business activities. These are examples of how costs can be separated after activities have occurred. Information about SCC measurements must be based on actual costs rather than calculated costs in order to achieve more reliable results to be used when taking decisions regarding the structure of the supply chain (Pettersson & Segerstedt, 2012).

Information must be accurate and valid to help managers when taking decisions regarding processes, products, services, and customers. Integrating information systems and applications among supply chain partners should be reliable, secure, and fast to meet customer demands. Seuring and Goldbach (2010) explain that both cost management and SCM are platforms for a wide variety of methods, concepts and instruments. It cannot be expected, that looking at the intersection will lead to a single, clear concept. Hence, a realistic cost knowledge based on actual and realistic costs is one of the keys to acquire positive benefits from cost management. One must also realize that there must be a clear understanding of customers' requirements and there must be a right match between what customers expect and what suppliers are able to provide.

2.3. Customer channel management

Customer service as a potential means of differentiation is increasing due to higher customer expectations. The general increase in wealth of several countries is driving customers not

only to desire more variety of products, but also demanding better levels of service to be associated with those products (Harrison & Hoek, 2008). Markets are increasingly becoming customer oriented and organizations are driving their attention to improve customer service. The same applies to suppliers who need to improve their business services in relation to their industrial customers. An example lies in the ever increasing customer demand on the availability of products which pushes suppliers to shorten their lead-times. A common management system which is customer-centric is the so called just-in-time (JIT) strategy that strives to improve the overall business performance by making products available to customers as fast as possible. Supply chains are evolving towards satisfying customer needs in order to increase customer value as a means to achieve competitive advantage. Increasing customer value can be achieved not only by pursuing one unique strategy for every customer type, but rather by adopting a specific strategy to a specific customer in order to adapt services to the level of demand arising from each customer. Cohen and Roussel (2005) mention that more and more companies have to develop multiple supply chain strategies so that they can adapt their needs to market uncertainty and customer demand variability.

Furthermore, supply chain strategies are starting to view the supply chain as part of an extended business architecture and consider key targeted outcomes with suppliers, customers, and partners as core elements. A key facilitating mechanism in the evolution of SCM is a customer-focus corporate vision, which drives change throughout a firm's internal and external linkages as indicated by Tan (2001). Christopher (2011) indicates that to create competitive advantage, companies have to deliver greater customer value in which the difference between perceived benefits and total costs have to be superior to other players in the same market or segment. Basically customers have to be provided with the right level and quality of service that they require and doing so at the least cost to the total supply chain. This phenomenon is likely to occur only through improved re-allocation of resources, or, by other words, by strategically align every firms' resources for the purpose of attaining higher levels of customer value. Once again it is important that customer strategies are developed to fit customer needs to produce sustained operational and financial performance. An important aspect concerns to how organizations align their strategies, cultural capabilities and leadership styles with respective customers. In this regard, an accurate interpretation of the marketplace is needed not only on the basis of financial concepts but also taking into attention the world of human behavior (Christopher & Gattorna, 2005).

The segmentation of business activities according to customer type is a starting point to understand and develop appropriate strategies that are meant to address customer demand variability with more precision. Nowadays segmentation strategies are being paid much more attention due to supporting managers defining more accurately the level of customer service. According to Harrison and Hoek (2008) segmentation defines how a given market might be broken up into different groups of customers with similar needs. These segments don't just concern to marketing management, but also to logistics due to the main function of serving customers. The 'buying behavior' of customers stands for an important characteristic for companies which intend to segment their services. As Christopher and Gattorna (2005) state, customers tend to demonstrate a limited number of 'dominant' buying behaviors for any given product or service, and that they may actually change if a current situation changes.

According to them, Table 1 provides an example of 4 types of buying behavior that appear to be the most common in many product/service situations and different types of corresponding supply chains, which constitutes the 'multiple supply chain alignment' scenario. However, they are not the only ones possible since the mix of these 4 buying behaviors vary across product/service categories and countries. The main purpose lies in identifying the mix of these and any similar behavior segments for a specific business product or service category. Furthermore, when this step is accomplished, pricing strategies based on specific customer segment can be created to adjust service levels to the 'new' reality, which is often common in business-to-business marketplaces.

According to Christopher and Gattorna (2005), the 'Collaborative' buying behavior is concerned with developing trustful customer relationships and predictability, rather than just pricing matters. The 'Consistent' buying behavior is focused on predictable low-cost service, and thus very price sensitive. The 'Dynamic' buying behavior is price aware, but customers exhibiting this type of response will pay a premium if their largely unpredictable and demanding behavior is met, especially if they are answered quickly. Finally, the 'Innovative Solutions' buying behavior is solely concerned with quick and creative solutions, regardless of the price being practiced. This represents an example of several sets of buying behaviors that can be used by suppliers to facilitate the adoption of specific supply chain strategies.

Table 1: Broad range of product/service categories associated to dominant customer buying behaviors (Christopher & Gattorna, 2005).

Collaborative	**Efficiency/ Consistency**	**Demanding/ Quick Response**	**Innovative Solutions**
Close working relationships for mutual gain	Consistent response to largely predictable demands	Rapid response to unpredictable supply and demand conditions	Supplier-led development and delivery of news ideas
• Mostly predictable • Regular delivery • Mature or augmented products • Primary source of supply • Trusting relationship • Teamwork / partnership • Information sharing • Joint development • Forgiving • Price not an issue	• Predictable demand within contract • Regular delivery • Efficiency low cost focus • Multiple sources of supply • Little sharing of information • More adversarial • Standard processes • Power imposed • Transactional • Very price sensitive	• Unpredictable demand • Commodity relationship • Time priority / urgency • Opportunity focus • Ad hoc source of supply • Low loyalty, impersonal • Fewer processes • Outcome oriented • Commercial deals based on pragmatism • Price aware	• Very unpredictable demand • Higher risk • Flexible delivery response • Innovation focus • Rapid change • Individual decision-making • Solutions oriented • Management of IP • Incentives • No price sensitivity

A study conducted by Amit et al. (2005) also demonstrated that once TSCCs are identified and modeled, it is possible to understand and predict the outcome of each market scenario and to devise policies accordingly to minimize TSCC. They presented several different models (cooperative model, contract farming model and collaborative model) to minimize the TSCC under different scenarios – optimistic, most likely and pessimistic – as an answer to improve the performance of the supply chain by decreasing the cost ratio.

When a customer issues a purchase order to its supplier, the characteristics of that order follow a set of specific criteria containing important information regarding the target segments. These characteristics define the marketing mix as a set of marketing decisions that is made to implement positioning strategy and to achieve the associated marketing and financial goals. The range of these characteristics are often associated to the popular marketing mix classification termed the 4 'Ps'. Where 'product', 'price', 'promotion' and 'place' represent the fundamental standards to categorize specific target segments. In a customer-oriented version, Schultz, Tannenbaum, and Lauterborn (1993) proposed the 4 'Cs' classification so that the model could be adapted to industries that focus on customers and not just on manufacturers. Hence, the authors summarized that 'product' is replaced by 'consumer', shifting the focus to satisfying consumer needs; 'price' is replaced by 'cost', reflecting the total cost of ownership; 'promotion' is replaced by 'communication', which represents a broader focus; 'place' is replaced by 'convenience', with the rise of internet and hybrid models allowing easier ways of purchasing. Logistic activities contribute fundamentally to the 'convenience' decisions, as well as supporting 'consumer' and 'communication' decisions.

In this regard, Weil and Maher (2005) note that the concept of supply chain consists of logistics and marketing activities that consume resources in the organization. As mentioned before, logistics encompasses planning processes, implementation, and controlling with efficiency, cost-effective flow and storage of raw materials, inventory, finished goods, and related information from the point of origin to the point of consumption, to satisfy the end-customer requirements. Figure 4 depicts an insight into a complete physical and informational logistic activities perspective, forming a closed loop linking both upstream suppliers and downstream customers (Weil & Maher, 2005). The activities necessary to perform the physical and information flow result in several costs related to people and assets required for moving and storing material through the various stage of transformation. On a demand chain perspective, the information on the top portion of the exhibit, often translate demand and inventory status into production orders and materials requirements. These activities include the cost of transactions, planning, and change control typically considered a part of the support burden. All together, these activities form the backbone for managing logistics costs.

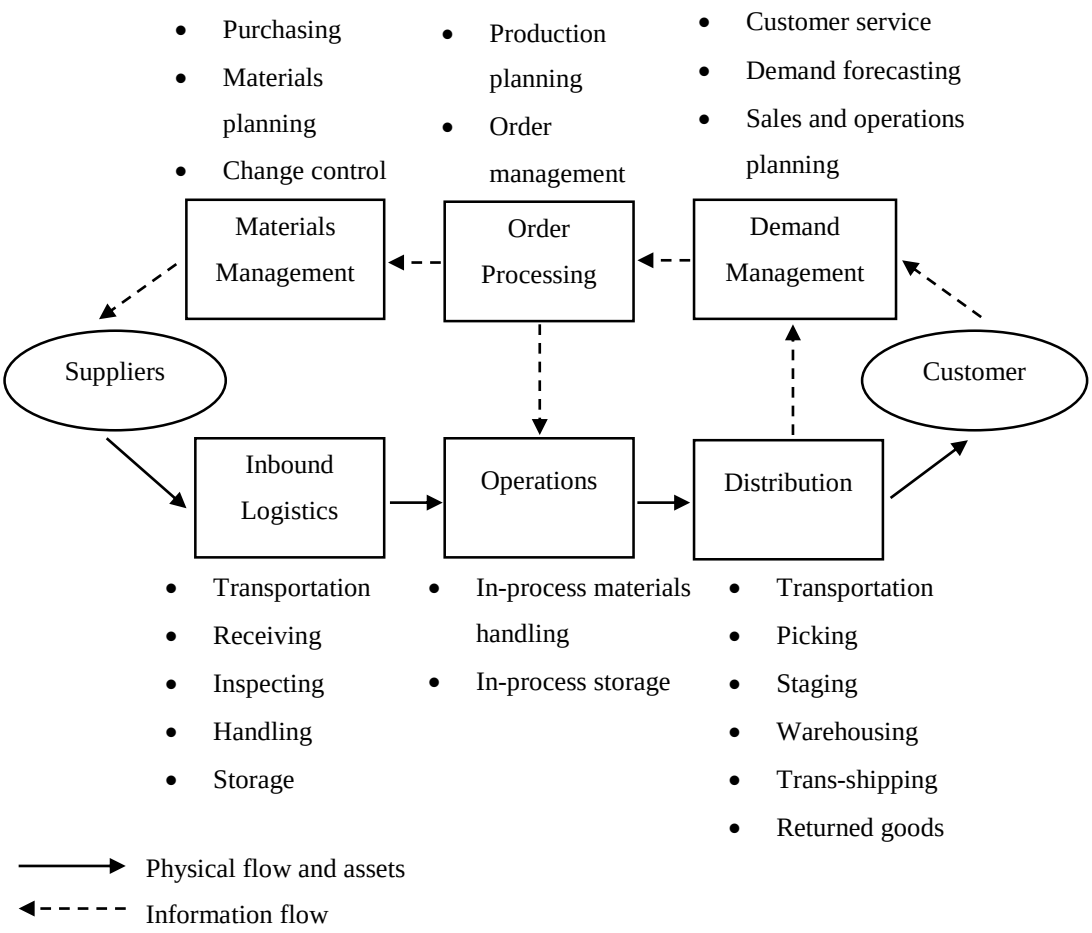

Figure 4: Complete physical and informational logistic activities (Weil & Maher, 2005).

Weil and Maher (2005) add that in addition to logistics costs, firms incur marketing and sales costs downstream the chain, mainly because these costs are often related to customer activities. Examples of different costs from these activities include the costs of selling, order taking, merchandising, advertising, promoting, and customer development. (Freeman et al., 2000) also inform that companies have to understand individual CP through an analysis of the cost dynamics from various customers and channels they serve. Hence, they suggest an extended analysis to the cost structures of several activities related to the cost of serving specific customers. The cost structures are composed by sales and marketing, order administration, and logistics and distribution, which for each of them there are specific cost drivers. The activity drivers are mainly customer specific and may vary from customer to

customer, depending on the characteristics of the business itself. Thereby, the drivers are strictly influenced by the type of distribution channels being used and the product lines being commercialized. As mentioned before, the measurement of the costs incurred to serve customers at this level is a critical factor to control overall business activities and develop strategies to better allocate resources.

2.4. Customer-driven supply chains

Just as important as any other business concept, resource utilization and specifically the use of fixed and working capital is critical for decision-making. A common concept used to help managers evaluate the productivity of capital is the return on investment (ROI). It is one of the most commonly used approaches to support the evaluation of financial consequences of business investments, decisions, or actions. Used to evaluate the efficiency of any business activity, which doesn't necessarily mean that is the same as profit. According to Harrison and Hoek (2008), ROI is an important measure for assessing shareholder value and is underpinned by two main drivers

- increased profitability; and
- increased asset utilization.

These two supporting drivers are considered as key determinants for increasing ROI and thus driving up shareholder value. The comprehension of certain financial ratios that affect these two supporting drivers is essential when formulating an organization's supply chain strategy aiming at bringing high levels of customer service. Usually, financial ratios are based on historical information, and therefore have some limitations. However, these financial ratios can provide a number of advantages, such as the ones enumerated by Harrison and Hoek (2008) which directly benefit organizations. The proposed advantages can be:

- A benchmark for comparing one organization with another.
- Used as a comparator for a particular industrial sector.
- Used to track past performance.
- A motivator for setting performance targets.
- An early warning indicator if the organization's performance starts to decline.

Hence, by correctly addressing the financial ratios according to the characteristics of an organization's supply chain strategy, the two supporting drivers can be used to further increase ROI and assess shareholder value. Christopher (2011) explains that ROI is the ratio between the net profit and the capital that was employed to produce that profit. By other words, to calculate the ROI, the benefit (return) of an investment is divided by the cost of the investment, whereas the result is expressed as a percentage or a ratio.

Logistics management can impact on ROI in several different ways. Figure 5 highlights the major elements determining ROI and the potential for improvement through more effective logistics management. Clearly sales revenue through customer service and costs through logistic efficiency measures are responsible for originating profit. On the other side, cash, net receivables, inventory and fixed assets represent the capital employed. Every logistic element can affect the balance sheet in several different ways, aside from its impact on operating income. Improving the shape of the balance sheet through a more efficient use of a company's assets and resources has become a major priority for logistic managers who seek to reduce costs cross the supply chain network. Reducing costs can be achieved through an analysis of the total costs in order to minimize, e.g. the cost of transportation, warehousing, inventory, order processing and information systems, and lot quantity cost. Nonetheless, it is important to emphasize the importance of achieving the established customer service level.

According to Shapiro (2007), expanding the scope of total cost analysis is of utmost important to future improvements in SCM practices, more specifically to develop optimal solutions concerning overall performance. The author explains that, usually, in a typical consumer products company, there are a set of processes that are performed without a clear focus on reducing overall costs. These processes include the development of strategies concerning the sales department, which are determined by marketing managers. Furthermore, the plan is passed to the manufacturing department which is responsible to develop an appropriate production strategy. The joint marketing and manufacturing strategy is then passed to logistics managers who have the responsibility to develop appropriate transportation, warehousing and inventory strategies.

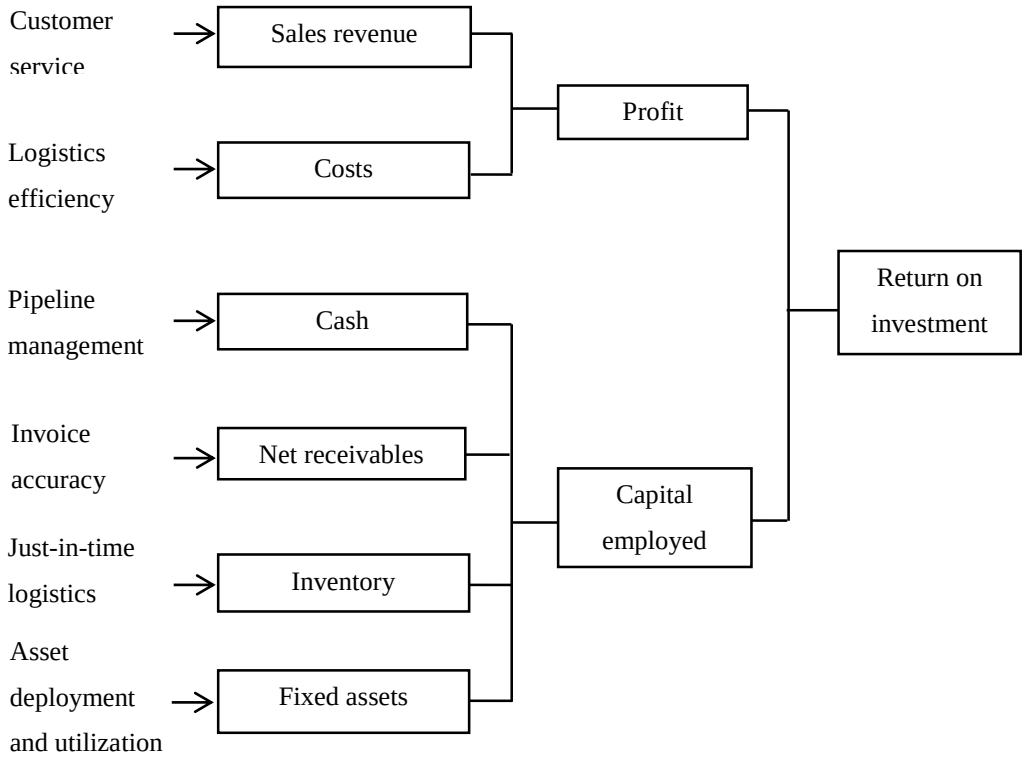

Figure 5: Logistics impact on ROI (Christopher, 2011).

However, although logistics managers seek to minimize the total logistics costs, serious challenges may occur since the integration of strategies for logistics, manufacturing and marketing is not entirely addressed. As a result, a company's supply chain performance may be significantly suboptimal. Braithwaite and Samakh (1998) provide insights to the cost impacts of dealing with large and small customers, as shown in Table 2, where the range of differences from every customer group can be quite remarkable.

The idea that can be withdrawn from Table 2 is that there are many differences among customer needs, depending on the nature of the business that is specific to both large and small customers. This results in an increased level of complexity if a company is to satisfy several customers with distinctive customer-driven characteristics with the goal to reduce its own operating costs. Consequently, many large companies are being forced to outsource their functions, especially distribution functions to 3PL providers. Hence, the role of the distributor in the chain is suffering major changes with this new paradigm.

Table 2: Customer Characteristics and Costs (Braithwaite & Samakh, 1998).

Customer-driven Characteristics and Costs	
Large Customers	**Small Customers**
Characteristics of demand	
Large quantities and ordered in bulk	Small orders, frequently with many items
Forward forecast often available	Capable of occasional large orders
Subject to erratic requirement changes	No forecasts
Reliability valued above short lead-times as tend to hold inventory	Rarely hold inventory. Require short lead-times
Still likely to place many small orders alongside large ones	Not usually well organized so still require reliability and predictability
Often impose logistics constraints around documentation and delivery times	More likely to accept standard logistics arrangements for delivery
Very demanding on returns for credit and clean documentation, will only pay on time if this is right	Higher risk with credit control and collection
Cost impact areas	
Low physical logistics costs for the bulk of the volume, as full pallets and truck load distribution with plan able lead-times	High costs of order processing as few items and low value
Low order-processing costs due to high value order line	High costs of picking and packing
High costs associated with specials and singles usually supplied at bulk prices	Higher costs of delivery in relation to order value
High administration costs of covering mistakes to secure payment	High costs of credit control and debt collection with risk of bad debt

At some extent, 3PL providers are being faced with formidable challenges. Ross et al. (2007) affirm that nowadays 3PL providers are faced with rapidly increasing costs, the proliferation of specialized service providers, and increasing reliance on technology investment to coordinate processes, which can all lead to disappointing service and poor resource utilization.

Competing on a customer service level allows companies to tailor their offerings to their customers' specific needs, which may result in exceptional customer service. The ability to

integrate internal processes and systems with those of key customers is a core skill. According to Cohen and Roussel (2005), companies that are mainly focused on customer services tend to develop the ability to segment their customers. They understand the relationship between the cost to serve and profitability, and can assess the cost of offering customized services. As a result, they are able to avoid offering customized services to customers who don't meet hard business criteria, especially those who are unprofitable. They also tend to focus on the higher-value segments of an industry and on developing relationships with their priority customers, resulting in lower account turnover and a decrease in customer retention costs. The most competent companies understand that not all customers can be served the same way. Not just because customers demand specialized services but also because it is just not profitable anymore. Braithwaite and Samakh (1998) state that it is quite difficult for a business to answer every customer or serve many channels simultaneously, all at the lowest cost and consistent with the market requirement. In doing so, companies need to identify how they will differentiate themselves and drive their supply chain to best-in-class performance for that basis of competition. This sharp focus sets companies apart from the competition and helps them gain a competitive edge.

In this regard, Cohen and Roussel (2005) propose current and next generation dominant practices that can be assigned to supply chain strategies (Table 3). Furthermore, it also encompasses five supply chain themes that are addressed based on both practices where the main differences can be perceived. According to the authors, a company's current situation of dominant practices are mainly concerned with internal affairs, which is incongruent with the increasing market competition to attain higher levels of customer value. Current dominant practices aim at developing a strong image of what are the main business concepts of a company, through the promotion of functional excellence, following specific product standards irrespective to customer segmentation criteria.

As mentioned before, this perspective is changing due to major pressures arising from market competition, where the customer is idealized as a core focus for creating differentiation strategies. Next-generation of supply chain strategies will continuously support improvements in productivity, but will also drive the achievement of business-level outcomes, with a strong focus on the customer.

Table 3: Next-generation characteristics of supply chain strategy (Cohen & Roussel, 2005).

Theme	**Current Dominant Practice**	**Next Generation Dominant Practice**
Supply Chain Strategy Scope	Focus is on the internal organization	Focus is extended to key customers and suppliers
Supply Chain Strategy Content	Focus is on functional excellence, with corresponding emphasis on functional metrics such as unit manufacturing costs and purchasing price variance	Functional strategies are integrated as part of the overall supply chain strategy to achieve enterprise-level performance improvements in areas such as supply chain management costs, order fulfillment lead time, on time delivery, and inventory days of supply
Supply Chain Support of Overall Business Strategy	Supply chain strategy is focused on core (plan, source, make, deliver, and return) capabilities and performance objectives	Supply chain capabilities and performance objectives are aligned with marketing and sales, technology, service, and product development strategies
Supply Chain Segmentation	One supply chain model (a set of supply chain capabilities and performance objectives) is dominant, with alternative approaches managed on an exception basis	Multiple supply chain models are developed and optimized based on customer and supplier segmentation
Cross-Enterprise Extension	External relationships with customers and suppliers are managed using existing roles, processes, and metrics	Effective external relationship management is nurtured as a core competency and enabled by new roles, processes, and metrics

Moreover, when developing advanced segmentation strategies, the identification of profitable groups of customers that differ in current and future profitability to a firm is critical to financial forecasting and developing appropriate market strategies. According to Zeithaml, Rust, and Lemon (2001), this approach extends beyond the adoption of segmentation strategies because it tracks costs and revenues for groups of customers, and thereby capturing their financial worth to companies. Once profitable partners are identified, the firm is able to offer products, services, and service levels in line with the identified customers.

2.4.1. Customer profitability analysis

At some level, firms are aware that their customers differ in profitability, in particular that a minority of their customers' accounts for the highest proportion of sales or profit. Usually large databases and better analytics often reveal greater distinction among customers. Triest (2005) conducted a study concerning CP margin at a hygiene company, attempting to identify the variables that caused variations on higher profitability margins from large-volume customers. He states that an accurate analysis of every customer's profitability level requires an assessment of the costs at the customer service level, and not only at the product manufacturing level. The results provide insights regarding the relationship between a company and its customers, and how the cost of products or services offered by firms are only a particular part of the total costs incurred in the relationship.

Many authors agree that there are significant differences in profitability among all customers. The 80/20 rule addresses this subject by defining that 80 per cent of the profits of a business come from 20 per cent of the customers, while the remaining 20 per cent of the profits originate from 80 per cent of the customers (Christopher, 2011; Kaplan, 1989; Zeithaml et al., 2001). Christopher (2011) emphasizes that the Pareto Law, or 80/20 rule, provide the basis for developing a more cost-effective service strategy. Once CP is well known, companies could develop strategies to benefit key customers by proving high levels of service, whereas less profitable customers could receive a more flimsy service since not all customers are equally profitable. The curve in Figure 6 shows how CP can be captured following the 80/20 rule. According to Christopher (2011) the curve is often divided into 3 categories: the top 20 per cent of products and customers by profitability are the 'A' category, accounting for 80 per cent of sales and profits; the following 50 per cent or 'B' category account for 15 per cent of sales and profits; and the final 30 per cent are category 'C' accounting for only 5 per cent of sales and profits. The analysis does not imply that the proportion will always be exactly 80/20 since the distribution is arbitrary and not all companies have the same results, they will be near that range. However, the notion that large-volume customers will eventually result on high levels of profits is not entirely correct.

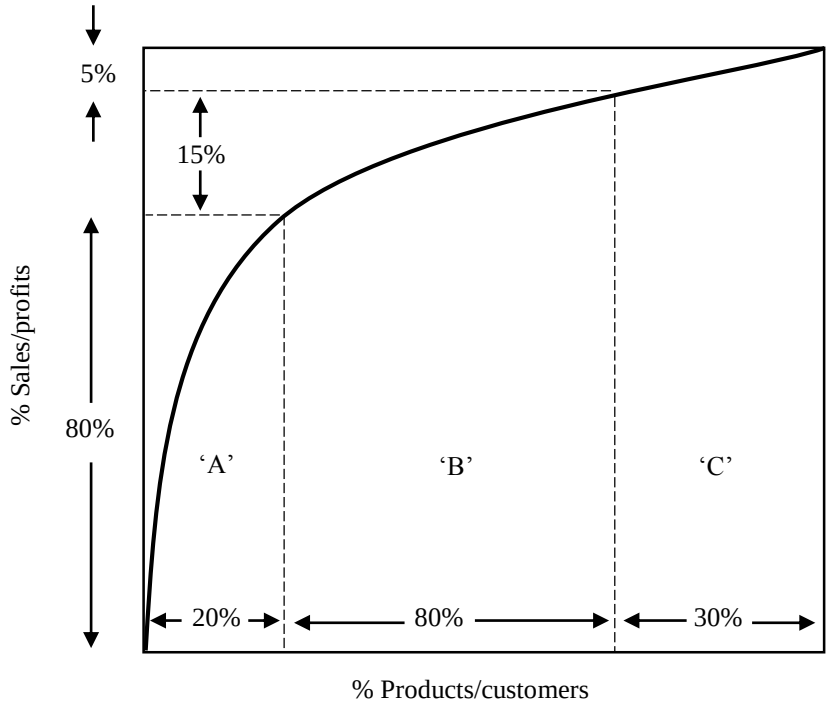

Figure 6: The Pareto Law or 80/20 rule (Christopher, 2011).

On this regard, Kaplan (1989) demonstrated on a study that, even though large customers represent most of the sales, they can be either the most profitable or the least profitable to the supplier. He concluded that 20 per cent of the customers usually generate 225 per cent of the total profits, whereas 70 per cent of customers are on the balance point and 10 percent generate a loss of 125 per cent of total profits. In fact, Braithwaite and Samakh (1998) state that a small portion of customers is usually responsible for a large portion of profitability, and also a large customer with large volume can be unprofitable. Hence, management may categorize customers according to their profitability performance to facilitate the identification of appropriate strategies (Figure 7). Guerreiro et al. (2008) unveil that CP can be assessed by deducting the costs to serve customers from the manufacturing contribution, which can be significant for commercial activity management, commercial policy reviews, and negotiations with loss-making customers. Other strategies can be developed to increase the efficiency of current activities to serve the customer by reducing costs.

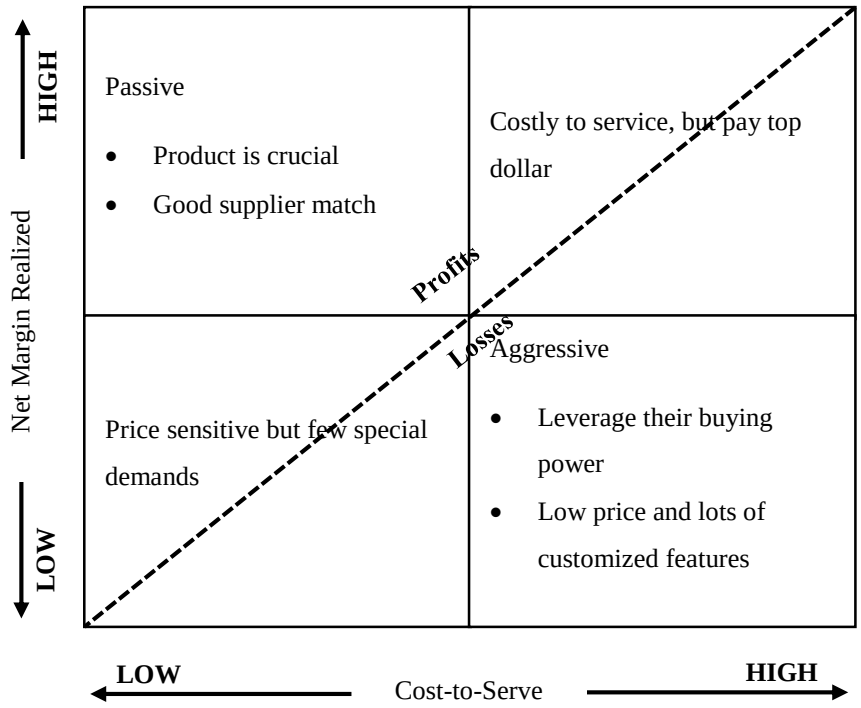

Figure 7: Customer profitability determination (Kaplan & Cooper, 1998).

The vertical axis is related to the net margin that results from the net sales price after sales promotions, deducting production costs. The horizontal axis is related to the costs of serving the customers. Customers which are above the diagonal line are considered profitable because of having their margins high enough to compensate for the incurred CTS. On the other hand, customers bellow the line have a higher CTS. Christopher (2011) explains that even though the objective of any logistics system lies in providing customers with the expected customer service, there will inevitably exist service priorities. To overcome the challenge of customer service, management must identify the real profitability per customer and only then develop strategies to determine the effects of customers' cost on profitability. Even though loss-making customers present a big challenge to companies, Guerreiro et al. (2008) propose that instead of eliminating them, they should be considered as clients that require detailed plans to identify any inefficiencies when performing activities, and incentive plans to develop better relationships to achieve improvements at the business level. Managers are becoming aware that it is neither practical nor profitable to deliver high-quality services with a view to complying with all customers' expectations. Thus, it is this becoming

clearly apparent that an examination of the key elements of costs and revenues in the customer-profit equation enables a firm to increase current and future profitability in its customer portfolio.

2.4.2. Customer categorization

Companies striving to differentiate their services through innovation now realize that they can achieve higher profits by recognizing that different customer groups have quite distinct responses to marketing efforts. In this regard, Zeithaml et al. (2001) uses the example of the well-known Federal Express Corporation, which adopted an efficient method to rank its customers as "good", "bad", and "ugly" on the basis of customer profitability. Consequently, rather than providing the same level of marketing efforts on every customer, the company had the chance to concentrate its efforts on the "good" customers, while simultaneously attempting to improve the "bad" ones into "good" customers, and if necessary discouraging the "ugly" ones. As mentioned before, companies are discovering that they do not need to serve all customers in the same way but according to their profitability performance. Mostly because many customers cost significantly more to be served and have a low potential to become a profitable proposition for the supplier, even in a long-term relationship. Therefore, Zeithaml et al. (2001) proposed a profitability-based customer-segmentation model, often described as the "customer pyramid" model, which encompasses four levels of customer profitability. The authors inform that the proposed categorization model does not necessarily translate every situation. While different systems and labels can be adopted, the model is composed with the following four levels:

- The **Platinum** level describes the company's most profitable customers, typically those who are heavy users of the product, not overly price sensitive, willing to invest in and try new offerings, and are committed to the firm.
- The **Gold** level differs from the Platinum level in that profitability levels are not as high, perhaps because the customers want price discounts that limit margins. They might not be as loyal to the firm even though they are heavy users in the product category, they might minimize risk by working with multiple vendors rather than just the focal company.

- The **Iron** level contains customers that provide the volume needed to utilize the firm's capacity but whose spending levels, loyalty, and profitability are not substantial enough for special treatment.
- The **Lead** level consists of customers that are costing the company money. They demand more attention than they are due given their spending and profitability, and they are sometimes problem customers, complaining about the firm to others and tying up the firm's resources.

Once customers are categorized according to their respective levels, it is expected that profits will eventually vary from level to level. Thereafter, the 'Platinum' level consists of a tiny group of customers that represent the most profitable return for the supplier. As for the levels of 'gold', 'iron' and 'lead', larger groups of less profitable customers are considered. The customer pyramid is not specific to a single type of business. However, certain businesses can provide more visible results from its application, such as companies selling directly to consumers, or intermediaries, especially those which perform frequently logistic activities. Companies desire to know the variations of profitability between their customers to ascertain the levels of service to offer. In some situations, it may happen that due to the use of limited or stretched resources, most profitable customers are not receiving the highest service levels, because there is no knowledge of that. Therefore, it makes financial and practical sense to implement the customer pyramid approach to rank a company's customers (Freeman et al., 2000).

Nevertheless, when maintaining profitability levels among business partners through the application of specific measures, it must be noted that these measures do not need to focus only on discounting and other price-related strategies. Hence, by lowering prices, often unnecessarily, the profitability of a given segment will also reduce. The adoption of the customer pyramid grants the necessary information to manage closely customer's profitability, using targeted and efficient strategies. According to Zeithaml et al. (2001), profitable customers can be pampered appropriately, customers of average profitability can be cultivated to yield higher profitability, and unprofitable customers can be either made more profitable or weeded out. Tailoring service to the customer's profitability level can make a company's customer base more profitable, increasing its chances for success in the marketplace.

Norek and Pohlen (2001) introduce three key issues regarding the necessary cost information to understand how individual customers drive costs and where to target improvement actions:

- The first deals with cost knowledge and how suppliers unveil their costs to accurately determine the costs of performing additional or shifted functions.
- The second refers to how suppliers measure CP on a detailed basis.
- The third regards to the allocation of costs and how suppliers assign the costs of performing specific activities to specific customers or by distribution channels.

The knowledge from these three key issues is of utmost importance if suppliers are to maintain or enhance profitability by adjusting the levels of service quality and the allocation of resources. Guerreiro et al. (2008) note that an accurate interpretation of CP is dependent on the assessment of profitability at the customer level, and not only at the product level, since the cost of products or services are merely one part of the total costs incurred in the relationship. Guerreiro et al. (2008) also state that activities such as order management, logistics, sales, marketing, and customer support are performed at different levels, according to the requirements that each individual partner possess. Therefore, by determining that different customer groups respond differently to marketing efforts, services can also be segmented in order to drive down costs when serving customers. The knowledge of different levels of profitability and the cost-benefit to serve various customers can be used to adapt or adjust the quality of customer service and the allocation of resources. In this regard, for Norek and Pohlen (2001), cost knowledge can definitely allow the improvement of relationships between business partners by creating more accurate internal budgeting and more accurate pricing strategies during negotiations. The identification of supply chain costs is a stepping in pursuing a strategy of low cost, differentiation, or both in order to achieve a sustainable competitive advantage.

3. Techniques for customer costing analysis

As the global industrial economy achieves higher levels of competition, businesses are forced to adapt their products and services to individual customer´s requirements, with the intention to achieve superior growth and profitability. As mentioned before, costs are incurred when satisfying customer needs through service activities which account for a large part of total SCCs. The determination of these costs at every stage of every activity is the first step in developing effective strategies to improve global supply chain performance. An improvement of the supply chain performance based on cost reduction requires that managers adopt a proactive management style focused on the long-term continuous improvement of the supply chain. Hence, over the years, many methodologies and techniques have evolved to help companies measuring the amount of profit and cost of each customer and channel they serve. The analysis of the costs incurred to serve the customer is important for a series of management practices, such as planning and control of business activities, which is routinely welcomed by managers. These methodologies and techniques are currently being used to improve and increase the competitiveness of organizations. According to Baykasoğlu and Kaplanoğlu (2008), the competition among logistics and transportation companies is strong and they are under pressure to create better business conditions. Logistics performance improvement is turning to be more and more important since the costs incurred with logistic activities have a considerable proportion in the total cost of products and services. As customer expectations increase, the complexity of the logistic processes increase driving up the proportion of costs

According to Guiffrida and Nagi (2006), improving supply chain performance in terms of cost reduction requires the adoption of specific performance metrics, allowing an accurate measurement of the costs incurred in the supply chain as a whole. These cost-based performance measures must be addressed correctly in order to ensure its compatibility across various processes and stages of the supply chain. Usually cost-based performance measures are known for providing supply chain managers with direct input into the capital budgeting processes used for investing in supply chain improvement initiatives. The measurement of the supply chain performance cannot be viewed as a means to focus only on optimizing local operations, but also with the intention to improve other supply chain partners according to

their performance. This is true due to the evolution of SCM, shifting the focus from the manufacturing perspective to a more customer-centric vision, in order to attain higher levels of customer value. Therefore, Guiffrida and Nagi (2006) affirm that the adoption of cost-based performance measures must be formulated to serve as integrating tools for fostering long-term, continuous improvement between and within the various stages of the supply chain. In doing so, the authors propose that other non-cost based measures should be applied by combining, for example, the balanced score card methodology with the cost-based measures, which are designed to measure processes linking various stages of the supply chain. The appliance of other performance measurements besides cost-based measures is certainly a plus to provide efficient improvements on the long term in supply chain operations. On a first step, it is necessary to define which elements of the supply chain are to be measured and only afterwards develop cost-based performance metrics to accurately estimate the costs. These supply chain elements might also vary from business to business, where the most common ones are usually associated with an activity pool, channel pool and product pool. There are many different methodologies to evaluate SCCs in different ways depending on what is to be measured and with which degree of accuracy. A cost-based analysis across the supply chain business processes should be viewed as one of the ultimate strategies to achieve competitive advantage. Hence, it requires that managers adopt an ongoing initiative incorporated into a framework that connects functional areas and organizations within the supply chain, rewarding those supply chain partners who are loyal to the practice in order to maintain a continuous improvement.

3.1. Activity-based Costing method

The ABC is a cost measurement tool widely adopted by many accounting managers and addressed by many authors as an object of study in current literature. This method enables managers to assess a company's cost performance in many different ways, by figuring out and quantifying casual relationships between cost objects, activities and resources. According to Kaplan and Cooper (1998), the ABC systems emerged in the mid-1980s to support managers acquiring accurate information about the cost of resource demands by individual products, services, customers, and channels. It offered the possibility to drive indirect and support expenses to activities and processes, and then to products, services, and

customers. Joon Jong and Brian (1997) explain that conventional cost accounting systems focus on units or particular products where costs are allocated to a product, often forgetting the importance of other factors, because it is assumed that each unit is assumed to consume resources. For Harrison and Hoek (2008), the traditional way of allocating indirect costs by associating them to products on the basis of direct labor is becoming difficult and inaccurate to manage. Direct labor used to constitute a substantial portion of product costs while, today, it rarely applies. Therefore, conventional allocation of costs only attributes of a unit per time, e.g. the number of direct labor hours, machine hours or material costs consumed in manufacturing the product. Gupta and Galloway (2003) add that TCAS often use a single cost driver, e.g. direct labor or machine hours as the basis for allocating overhead costs, which can provide misleading results and inaccurate measurements since they apply a great amount of costs to one single product or service. For Christopher (2011), the advantage of using the ABC system compared to other traditional costing systems is that it enables each customer's unique characteristics in terms of specific ordering behavior and distribution requirements to be separately accounted for.

As soon as the cost attached to each level of activity is identified (e.g. cost per line item picked, cost per delivery, etc.), it is possible to obtain a transparent picture of product costs. According to Baykasoğlu and Kaplanoğlu (2008), the ABC method assumes that cost objects (product lines, processes, customers, channels, market, etc.) use activities, and activities use resources. Joon Jong and Brian (1997) add that ABC systems focus on the activities performed to produce products in the manufacturing process and thus, incurred costs are traced from activities to products based on each product's consumption of the activities performed. According to Harrison and Hoek (2008), the ABC method recognizes that overhead costs aren't just ordinary costs that happen without a reason, but are rather caused by activities, such as holding products in store.

According to Raffish (1991), the ABC method assigns product costs according to every activity that is necessary to create the final product. An activity can be considered as a particular operation in the production cycle, or it can also be considered as the entire material acquisition process. The ABC system assumes that activities use resources, such as support labor, technology cells or utilities. Resources also include indirect costs of the organizations, which are allocated to the activity centers. Resource drivers are usually used during the allocation process of the resources to the activity centers (Baykasoğlu & Kaplanoğlu, 2008).

On the other hand, the agents that cause activities to happen are the so called cost drivers. Harrison and Hoek (2008) affirm that the procedure of determining cost drivers is often considered to be more valuable than the ABC system itself. A cost driver yields a cause and effect relationship on activities which invariably result in the consumption of the firm's resources. They are used to segment costs according to the diversity and nature of any relationship between the utilization of resources, the performance of activities, and the final cost objects. It would be preferable if all cost drivers for a given product could be identified, but in practice the number of drivers is usually limited to those that have the most significant impact on cost (Gupta & Galloway, 2003). However, the selection of proper cost drivers represents a great challenge to develop an accurate ABC analysis, as well as the deciding cost types, such as direct and indirect costs which should be determined precisely.

Joon Jong and Brian (1997) explain that on a first step, resource costs (power, set-up, material handling and supervision) have to be allocated through the use of resource drivers in order to trace them to cost pools identified within activity centers. Resource driver is an allocation rate of individual resources and provides information regarding the levels of resource consumed by activities. This procedure comprises the first stage of the ABC system, as it can be seen in Figure 8. The activity centers group several different production processes (activities), where the total cost of each activity center represent the sum of all cost pools traced from all resources. Furthermore, once the costs of activities (cost pools) are identified, the ABC method plans to distribute them to cost objects, which comprises the second stage of the ABC system. At this point, particular drivers have to be used to perform a correct allocation of the activity costs to the cost objects, in the same manner of the first stage cost allocation. Cost objects are loaded by the activity cost pools due to the predetermined second-stage cost drivers. In summary, the ABC system employs a two-stage procedure, the first and second stages of cost drivers when assigning costs to products. Initially, it traces costs to activities from the consumption of resources and secondly to cost objects from the consumption activities. According to Baykasoğlu and Kaplanoğlu (2008), similar to other traditional costing systems, the ABC also makes backward-looking in order to increase the precision of information and support forward decision-making. However, it is expected that in some cases there might be a disagreement when deciding which costs should be included in an analysis, especially when fixed costs have to be acquired.

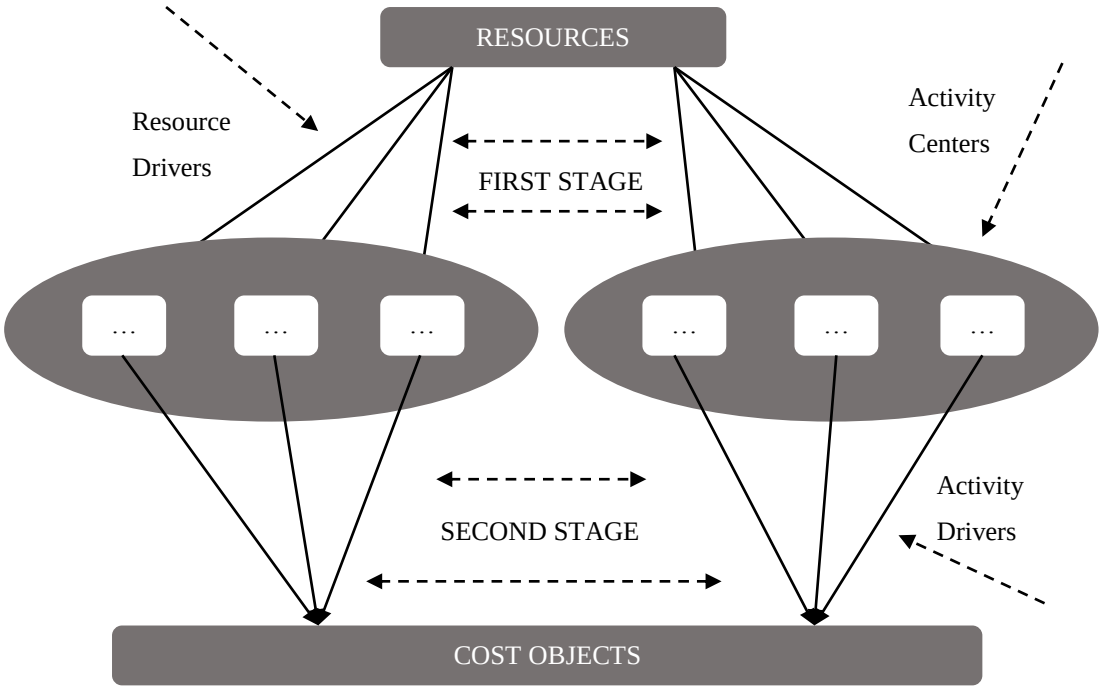

Figure 8: Cost assignment procedure in ABC (Turney, 1991).

For Kaplan and Cooper (1998), the evolution of the ABC systems let naturally to the Activity-based Management (ABM), which is the entire set of actions that can be taken, on a better informed basis, with ABC information. The ABM enables the organization to accomplish its outcomes by utilizing fewer organizational resources. By other words, the organization is able to achieve the same results at a lower cost. Kaplan and Cooper (1998) also explain that ABM accomplishes its objective through two complementary applications: operational and strategic ABM. Gupta and Galloway (2003) emphasize that the major change required for shifting from the ABC to the ABM system is one shifting from a cost assignment view (i.e. from resources to activities, and from activities to cost objects). To a process management view (i.e. from cost drivers to activities, and from activities to performance measures) as illustrated in Figure 9.

Turney (1991) states that ABM systems take the information obtained from ABC and apply it to the organization in a continual push for identifying improvement opportunities and ways to improve the processes. Gupta and Galloway (2003) add that ABM systems include both

financial and non-financial data which is very useful for managers, representing a shift from a strictly financial perspective to a more global system perspective. The ABM provides an examination to the processes and work-flows allowing an identification of the activities that add costs. With a broader knowledge of the costs, managers can rely on more accurate information, and develop more effective strategic decisions. In this regard, Gupta and Galloway (2003) explain that ABM systems examine all processes (or activities) that are actually relevant to the production of a product. Attempting to determine exactly which portion of each resource is consumed, i.e. which activities a particular product requires to be manufactured. The resulting information provided by the ABM systems can help on identifying which products and customers are the most profitable, whether processes are value-added or not, and where efforts leading to improvements should be made.

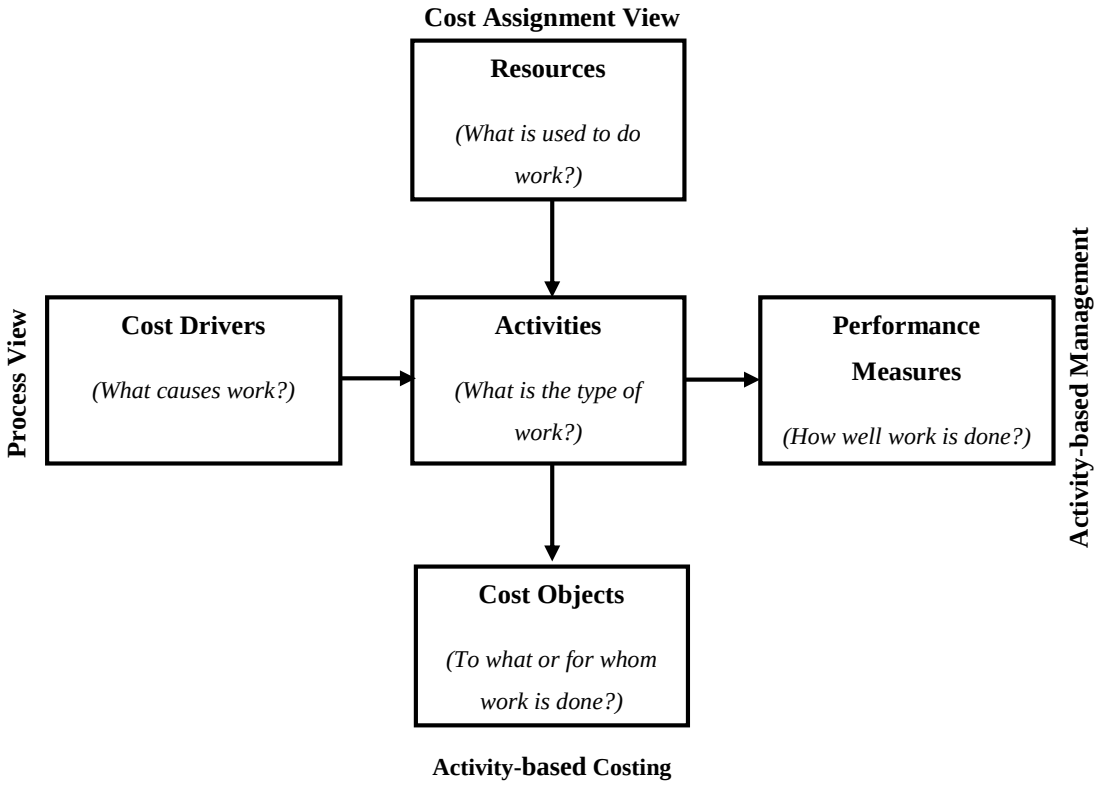

Figure 9: Activity-based costing/management system (adapted from Turney, 1991).

These systems are being adopted more frequently every day in an effort to obtain more reliable product costs, improve processes and develop improved marketing strategies. The

results have led to many improvements in various areas of industrial research, such as product design, internal processes, supplier relationships and customer satisfaction. In sum, Cokins et al. (1993) state very briefly that an ABM system development process involves:

- Identification resources (i.e. what is used to do work).
- Identifying resource drivers (i.e. what is assigning the cost of the resources to activities based on effort expended).
- Identifying activities (i.e. work).
- Identifying drivers (i.e. assigning the cost of the activities to products based on unique consumption patterns).
- Identifying the objects of work (to what or for whom work is done).

The ABM method has proven to be a useful tool in inflicting cost reductions, especially when it concerns to the cost of activities related to the production of a given product. In this regard, Joon Jong and Brian (1997) add that the objective that managers should keep in mind when designing an ABC system is to provide the most benefit possible at the lowest overall cost. In order to achieve this goal, Cooper (1990) proposes five design steps that should be adopted:

1. Aggregate actions into activities;
2. Report the cost of activities;
3. Identify activity centers;
4. Select first-stage cost drivers; and
5. Select second-stage cost drivers.

This method can lead to greater knowledge of a firm's business processes and underlying expenses. According to Drew, Sanghamitra, Erik, and Poomipak (2004), ABC represents a budget and analysis process that evaluates overhead and operating expenses by linking costs to customers, services, products and orders. Allowing managers to discern more accurately between profitable and non-profitable products or services, by filling in the gaps that traditional costing systems post. Once all individual costs are identified, a clear picture of the total cost of a process becomes transparent.

Furthermore, even though the adoption of ABC brings many advantages from the viewpoint of management, the implementation of ABC to service companies, with regard to companies

specialized in logistic services, may pose several challenges that are not generally common in manufacturing companies. A study conducted by Themido, Arantes, Fernandes, and Guedes (2000), proved that the application of the ABC methodology by a 3PL operator helped to identify costs and to develop optimization strategies to decrease logistic costs and improve relationships between clients. In this regard, the 3PL company was able to develop a deeper knowledge about logistic activities and offer a full range of services in the logistics area to its clients. The know-how associated to logistic activities is important if one is to capture the real costs of a product and the costs of serving specific channels and customers. However, the authors state that the application of the ABC method to a logistic operator poses many difficulties. Some of the reasons why the implementation of ABC to logistic companies is hard to overcome are stated by Rotch (1990):

- Output is harder to define.
- In many cases determining activities and cost drivers is not straightforward.
- Data collection and measurements is more complicated than manufacturing.
- Activity in response to service requests may be less predictable.
- Joint capacity represents a high portion of total cost and is difficult to link output related activities.

Hence, the resulting output from the organizations based on logistic processes cannot be represented as easily as the outputs of manufacturing organizations. As explained by Baykasoğlu and Kaplanoğlu (2008), the activities which are performed in manufacturing organizations are generally known with certainty and the information related to them is easy to acquire. The same does not happen with typical service and logistic organizations, e.g. it is harder to predict customer demand, market instability, service variations, complexity of logistic network, forecasting accuracy, etc.

3.2. Cost-to-Serve method

With increasing pressures from market competitors and the maturity of industrial economy, companies have to adapt their products to individual customers' requirements, by providing a set of services together with the goods being sold. By doing so, companies are likely to achieve superior growth and profitability. Mostly because we are in the era of segmentation

and specialization, where the idea that a company can perform all activities to all customers is no longer reasonable. Hence, companies must understand how to serve their best customers at a sustainable economic profit (Freeman et al., 2000). This poses significant challenges to marketing and sales representatives and more precisely to logistics managers. The issue is to bring the right product mix to every customer group, especially the gold ones, and to ensure that the channels being used are the preferred ones by customers. Braithwaite and Samakh (1998) add the importance to know how to meet or exceed customers' expectations in terms of service, at an affordable cost in relation to prices customers are prepared to pay. Customers are more likely to develop stronger ties with its suppliers and maybe willing to pay more for the service because they value it. However, managers need specific tools to understand the dynamics of current business environment in order to determine how organizations can choose between different set of strategies.

Moreover, companies are no longer advised to choose between being a low cost manufacturer or a market leader in terms of product and service (Porter, 1985). Instead, they should opt to do both at the same time. This is actually a growing trend nowadays, especially with the necessity to develop segmented supply chain strategies. The capability to operate in both ways is the means to achieve competitive advantage since businesses cannot afford to ignore the central role that high quality and low cost operations actually play. For Braithwaite and Samakh (1998), the issue concerning business functions lies in how information is managed. The integration of companies across the supply chain should be based on both principles of competitiveness and economic realities of how business adds value. The integration of supply chain functions requires that information is shared among supply chain partners. However, the functionally-based cost information, with which companies have traditionally worked with, is somehow limiting and blocking the insights it provides regarding the real status of how things actually are.

For Norek and Pohlen (2001), the lack of cost information may foster inaccurate perceptions regarding the overall performance of firms. Thus, the CTS method has to be designed in a way to address this challenge properly. The CTS method is considered a well-established approach for learning which customers and products matter most and how to manage them with the proper cost/service balance. CTS analysis provides an activity driven view of how specific dimensions, such as products, customers, and channels, consume resources and incur costs. With this complete insight, those responsible for bottom-line performance can

make critical and well-informed strategic decisions while quickly identifying the underlying causes of poor profitability (Acorn, 2013). Braithwaite and Samakh (1998) consider the CTS method as a means for major changes and achieve sustainable competitive advantage. In fact, they consider it as a driver for change. It is up to organizations to grasp opportunities to improve the supply chain functions in order to be successful in the entire business strategy. Some of the drivers for change are presented by Braithwaite and Samakh (1998), where the following terms represent core themes that are considered to be regularly encountered:

- cost variety
- customer channel management
- customer service objectives
- supply chain routing and network structure
- commercial and pricing policy
- functional cost emphasis and personal rewards

These drivers aren't, however, well addressed by common cost accounting systems. It is important that finance systems have the ability to analyze these drivers in detail. According to the authors, new tools do not need necessarily to replace conventional accounting systems because they should be used to other purposes, neither should activity-based techniques be elaborated.

According to Drew et al. (2004), logistics management is becoming a major step in the process of meeting customer demand. Firms' top management is now more closely involved in logistics decisions due to the increasing importance in relation to the consequences of making such decisions. The impact on managing logistics costs is important because it affects product profitability, product pricing CP, and ultimately, corporate profitability (Smith & Dikolli, 1995). The better the understanding of logistics' importance and its mechanism, the easier it is for firms to develop strategies to attain competitive advantage derived from logistics and supply chain activities. However, Drew et al. (2004) emphasize that managers should rely on more accurate costing systems to correctly assess logistics functions in order to identify the profitability a firm's customers. To do that, companies require precise financial information regarding the activities necessary to serve customers. The results allow the development of solutions to reduce overall supply chain costs and to

reconstruct logistics processes. The success of this venture is tied up on the capacity of a firm to accurately trace costs to, e.g. specific products, customers, and distribution channels.

Nowadays customer service is playing a major role in a firm's competitive strategy. For that reason, there is a growing need for more accurate costing methods to identify the performance of specific activities, customers and products in the supply chain. In this regard, Freeman et al. (2000) state that managers need specific tools to understand the dynamics that costs play, and to determine how the organization should chart its best way forward. However, it is important that managers do not get bogged down with too many details that cannot be explained. Furthermore, Braithwaite and Samakh (1998) provide five key drivers for internalizing supply chain thinking for an organization, which are:

1. The importance of knowing costs;
2. Organizational re-balancing;
3. Outsourcing and shared cost structures;
4. Avoidable and fixed costs; and
5. Risk and timing.

Moreover, these key drivers are part of CTS thinking and constitute important aspects of the CTS method. As for the first key driver, an understanding of how cost behaves through the supply chain, taking into account the combinations of products and customers, is essential to overcome many business challenges associated with the supply chain. According to Braithwaite and Samakh (1998), supply chain managers are constantly faced with decisions that require an understanding of the cost knowledge in order to identify what to change, and how to prioritize such changes. The authors state that if the theme of cross-functional organization based on process is to be realized, then the business needs a view of the true process costs and the factors that drive those costs. However, conventional methods of recording and managing cost through general ledger and functional budgeting controls proved to be inadequate for the process of integration. The authors add that the role of finance as the treasury function with its emphasis on accuracy and caution often obstructs the adoption of new methods of looking at the business. The important thing is to create a simpler method to analyze process-based costs, without going into excessive details. The knowledge of knowing costs facilitates the improvement of relationships between supply chain partners by creating more accurate internal budgeting and more accurate pricing in

negotiations. The method has to be capable of being tied back to the cost base of the business. In this regard, Norek and Pohlen (2001) affirm that identifying costs is the first step in pursuing a strategy of low cost, differentiation, or both in order to achieve a sustainable competitive advantage.

Organizations need to estimate costs for several reasons. Weil and Maher (2005) explain that cost knowledge can be used for three primary purposes: decision-making, planning and standard setting, and cost management.

1. Decision-making: When deciding among alternative actions, managers must project the likely consequences of each alternative, including its effect on costs. The costs of alternative actions often become a major factor in decision-making, especially during the development of strategies on the tactical and/or strategic levels.
2. Planning and standard setting: In planning the future of an organization, managers specify the activities that they expect people in the organization to perform. Cost estimation assigns costs to those activities. Based on the costs of component activities, managers forecast the likely costs of the organization, prepare financial forecasts, and estimate its cash flows. The projected costs of the component activities may also serve as standards or targets for monitoring the performance of departments and employees.
3. Cost management: Organizations must manage costs to be successful. Analysis of the costs of operations and services in terms of their component activities may identify reengineering opportunities for reducing costs and improving effectiveness. Thus, the process of cost estimation can help managers discover advantageous alternatives.

The advantage of knowing the costs incurred to serve customers is the bottom line to manage supply chains with great detail. Furthermore, the second key driver is about organizational re-balancing. For this driver, the authors explain that when the costs of performing a given business are known to a sufficient degree of accuracy, it is possible to draw strategies and work towards a new paradigm. Braithwaite and Samakh (1998) explain that in the same way that companies have internalized processes like planning, forecasting and financial budgeting, the process of balancing the organization is one that must be learned and internalized. Figure 10 illustrates an example in which the issues arising from the CTS

analysis can be used to ascertain a new balance in the business, by developing appropriate strategies. Moreover, the CTS analysis allows the possibility to calculate costs at the individual transaction level providing the most accurate representation of profitability (Acorn, 2013). Traditional costing methods spread indirect CTS expenses across customers and products taking no account of the unique needs and cost drivers of certain customer and product types.

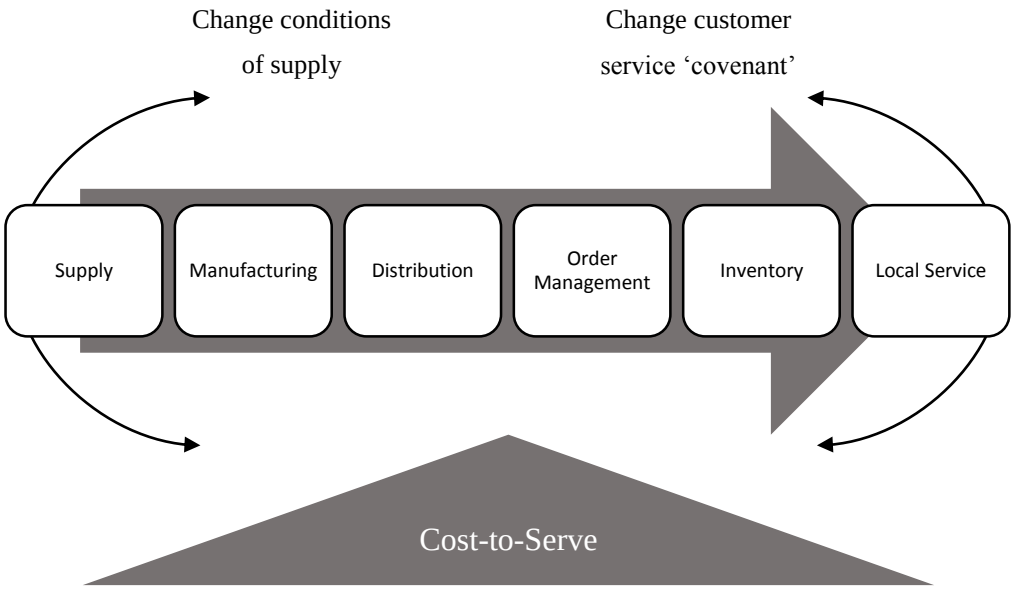

Figure 10: Re-balancing the organization using supply chain CTS (Braithwaite & Samakh, 1998).

The re-balancing of the businesses can be made at either or both: at a tactical level; at the strategic level. The third key driver regards to outsourcing and shared cost structures. Very briefly, the practice of outsourcing is a common thing nowadays in supply chain management. It can range from several areas, such as contracting out manufacturing, through to physical logistics, order management and call center operations. According to Braithwaite and Samakh (1998), the reason why companies outsource their functions regards to the fact that many of these functions are not core competencies. The choices for management making outsourcing decisions rest on either the supply chain function providing a unique capacity conferring competitive advantage, or alternatively, logistics costs can benefit from shared leverage to such a degree that they are taken out of the competitive arena. The fourth key

refers to the avoidable and fixed costs, which represent a big piece of the puzzle for most large businesses due to the ratio of fixed to variable cost. The authors emphasize that the implications of this in a CTS analysis and organizational re-balancing process can be profound. To facilitate such complex decisions, it would be appropriate if companies have a clear notion of their CTS. Finally, the fifth key is about risk and timing. The lower the risk of performing functions the better. Braithwaite and Samakh (1998) add that the ability through CTS analysis and modeling to create a prioritized and time-phased plan of change is a powerful means to segment risk, and handle the issues it creates in a controlled way. The CTS method allows that risk estimation is performed almost simultaneously since the data obtained is always informative regarding the profitability of channels, products and activities.

3.3. Differences between CTS and ABC

Christopher (2011) advocate that a large proportion of costs in a typical business are driven by logistic activities and the status of supply chain relationships. However, not only the transportation, storage, handling and order processing costs within a business need to be considered for cost measurement, but rather a total pipeline view of costs on a true end-to-end basis (from the supplier to final consumer). Managers are paying more attention to other variables in the supply chain, such as time minimization to enhance customer service and reduce non-value-adding activities to achieve cost reduction. The costs incurred to serve a customer are the product of a number of transactions a customer undertakes in a channel multiplied by the channel-specific costs (Gensler, Leeflang, & Skiera, 2012). The CTS provides an analysis and quantification of all activities and resulting costs incurred to fulfill customer demand for a product through the end-to-end supply chain. Accurate CTS metrics consist in modeling all supply chain activities in the network, and accumulating and properly allocating fixed and variable costs. Once a CTS model is implemented, one can actually make appropriate business decisions and financially optimize the supply chain. The ultimate goal lies in increasing a company's profitability by either turning unprofitable customers profitable, or by making profitable customers even more profitable. However, there are several methods that can be used to achieve this, and the distinctions between them are not always clear enough.

Both terms ABC and CTS are used to describe two different cost modeling methodologies, both of which require allocating indirect costs to cost drivers in a process or supply chain model. Thereby, a starting point to understand the differences between the two methods lies in recognizing that ABC is not CTS. Both two methods center on allocating indirect cost pools to products/services (overheads or fixed costs that are hard to attribute to a single order, shipment, or activity) following specific steps, seeking to clarify hidden costs in the process or network being examined. It is common that in companies, the finance department uses the ABC approach to cost out and predict the budget of departments, processes, or business activities according to specific cost drivers. Figure 11 illustrates the steps that allow an ABC analysis.

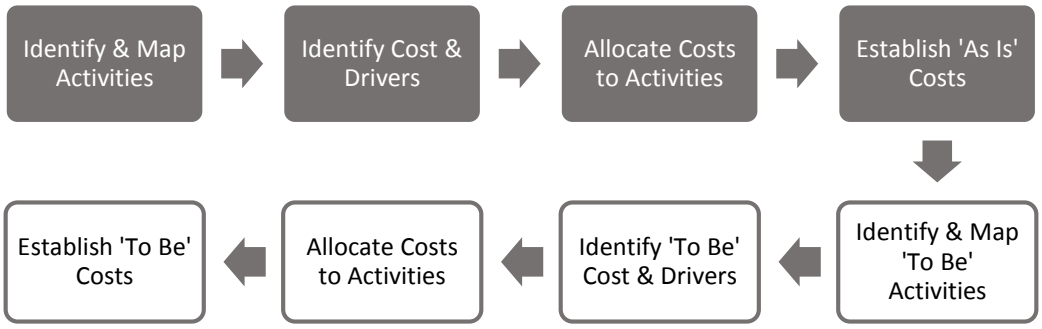

Figure 11: The ABC approach (O'Byrne, 2012).

The figure above presents a simple approach to how an ABC analysis is structured, without taking into account other variables that are present in a company's businesses. Thus, the ABC approach allows the identification of all activities present in a process or organization, and then it identifies the associated cost drivers, such as labor hours, or product quantity, which can be related to an indirect cost pool. In this regard, by developing a detailed model containing all value and non-value added activities performed in a given process, and associating activity drivers more directly to all of the relevant cost pools, the resulting cost model by far surpasses the precision of other traditional accounting methods for the determination of 'what if' budgets.

The ABC is a massive accounting tool, taking a large amount of time to prepare, typically used to supplement TCAS to analyze specific financial decisions. On the other hand, the CTS method (Figure 12) is typically used to an end sales item at the point of transfer to the customer.

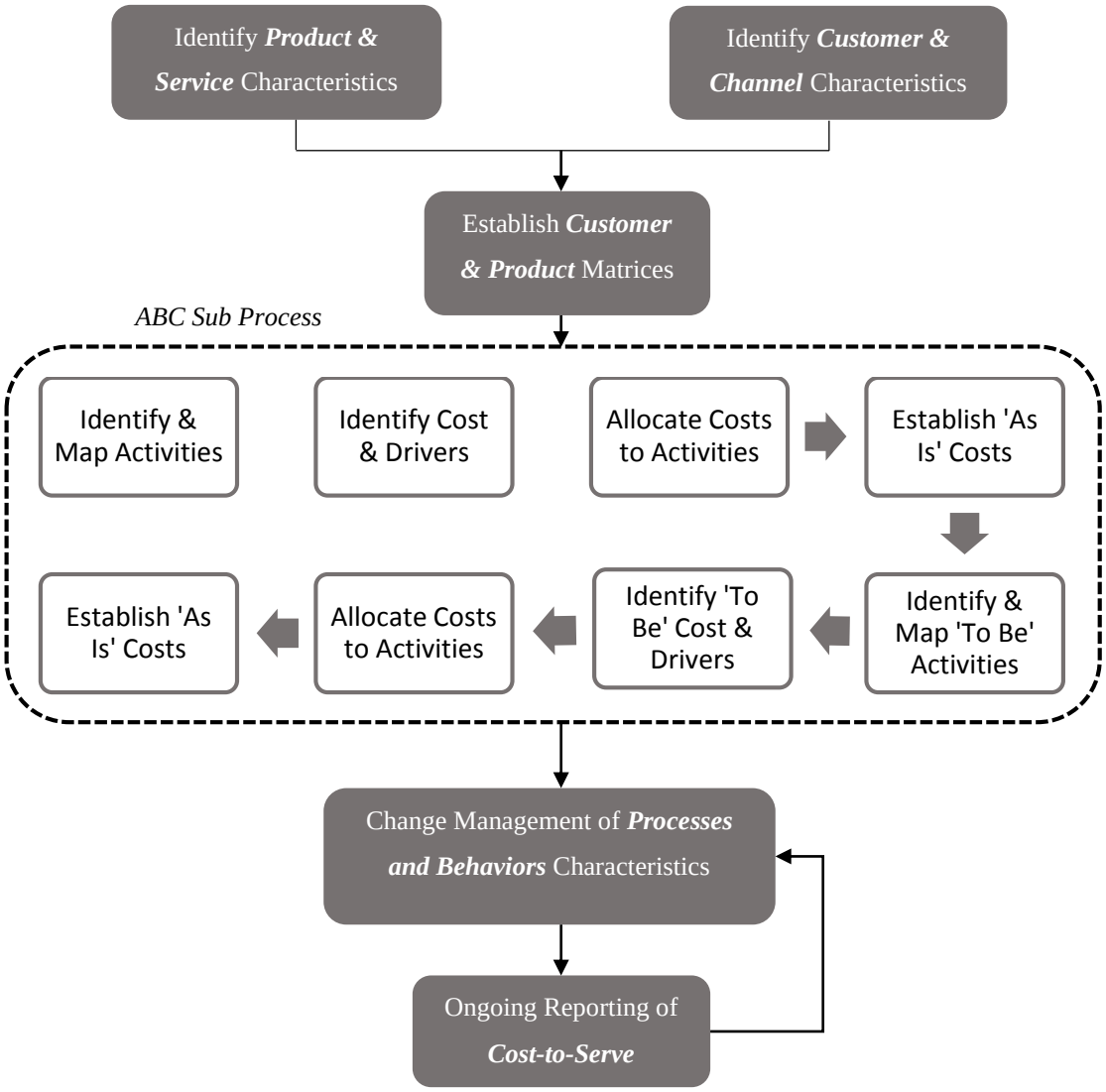

Figure 12: The CTS approach (O'Byrne, 2012).

The CTS method provides specific insights regarding the activities responsible for serving the end customer across all functional areas in the supply chain, and to accurately assess the total profitability of an individual product or item being sold to a customer. As it can be analyzed from Figure 12, the CTS approach incorporates all additional activities required to complete the customer delivery process in order to collect the final revenue. It starts by identifying the characteristics associated with the product and service to match them with the customer characteristics. Afterwards, with the necessary information, it is possible to establish the customer and product matrices. At this stage the procedure is very similar to the ABC method, although there might be slight differences due to the focus on the final consumer. After every step associated to the ABC sub processes are completed, the CTS method focuses on the customer characteristics that drive different service needs and costs in a business, modelling each major supply chain activity. The analysis has to identify where costs occur in the supply chain and determine the total cost of serving each individual customer at a stock-keeping unit (SKU) level, and at the designated level of service. There must be a recognition that the combination of different products and customers differ from channel to channel and, hence, the cost of serving those customers also vary. This analysis is very meaningful when it comes to identify the costs associated with product categories and channel types (individual product/channel combination analysis). Once the values of price and costs are added to the equation, it is possible to calculate the CP.

The following Table 4 provides a comparison between both methodologies, focusing on the main differences of their application in the supply chain. Hence, the ABC method provides a snapshot of the true cost of business processes or set of processes, while the CTS method provides the true total end-to-end cost of each individual product-customer combination. As mentioned before, the use of the CTS methodology allows the determination of CP, with the purpose to avoid deleting low margin products or customers, but rather to turn them all profitable. Very briefly, for a standard ABC approach, all costs are traced and allocated to products after a set of specific processes. For the CTS approach, the restriction that all costs must be related to products is removed. A more accurate perspective of product, customer and channel combinations can be achieved, enabling managers to understand cost differences in between those combinations.

Table 4: Comparison of ABC and CTS application in SCM.

Attributes	Activity-based costing	Cost-to-Serve
Application areas	All companies, particularly in manufacturing companies	All companies' supply chain management decision
Perspectives	Internal view of cost Cost-orientated	Internal and external view of costs Service-oriented
Major functionalities	Cost allocation; budgeting Accounting tools	Customer/channel profitability analysis Logistics/supply chain management tool
Managerial roles	Strategic decision-support tool	Strategic decision-support tool Tactical decision-support tool (logistics functions)
Major users	Finance & production department Senior Management	Product & logistics (SCM) department Senior Management
Methodology	Activity analysis	Activity analysis & constraint theory
Approach	Full absorption costing consideration	Not full absorption costing consideration (only concerns supply chain costs)
Profitability analysis	Product, Customer, Channel	Product, Customer Good at channel profitability analysis and other logistics implication analysis
Key variables	Cost drivers	Cost drivers & non-financial information (such as products' physical attributes)
Information	Balance to General Ledger	General Ledger & transaction information
Major implementation expertise	Accountant Consultant Production/sales managers	Logistics/supply chain managers Consultant Product/marketing managers

4. Cost-to-Serve framework

Current chapter is intended to develop a framework model in order to facilitate the interpretation of specific variables to allow the application of the CTS method over supply chain activities. As mentioned before, to correctly address the CTS analysis, a set of rules and steps have to be respected to meet the expected results. Initially, it is necessary to study the most relevant costs and identify which variables are to be chosen as inputs for further analysis (such as the channels, products, and corresponding activities). CTS metrics are developed by modelling and incorporating all supply chain activities in the network necessary to complete the customer delivery and collect the product revenue, by accurately allocating fixed and variable costs on the basis of certain cost drivers. Moreover, these activities are responsible for all costs incurred when serving any customer group (channels). With specific information regarding to net sales and total costs, the contribution margin of every product per channel is measured. Consequently, the costs accumulated in terms of customers are assessed taking into account every product line for every activity incurred. Furthermore, the collected data is used to model various cost elements, with the purpose to identify the margin after CTS in order to ascertain the profitability of each customer group per product line to later categorize customers according to a CP matrix. The purpose is to facilitate the identification of appropriate strategies. Thus, resulting values can be seen as outputs, allowing decision-makers to have an insight of the costs for serving specific customers, channels and products. The final information allows a profitability analysis of every account at the service level, which leads to the understanding of the cost dynamics of every customer relationship.

Thereafter, one has first to define a strategy to be applied during the CTS method in order to proceed with the identification and measurement of initial data. The diagram in Figure 13 illustrates a possible cost allocation process which can be used to determine the essential steps. Note that the costs belonging to the group of activities of order, processing, logistics, and marketing are deducted from net sales to determine the customer contribution to the company. However, this step is much more complex and requires the measurement of several variables that are a consequence of performing specific activities to serve customers.

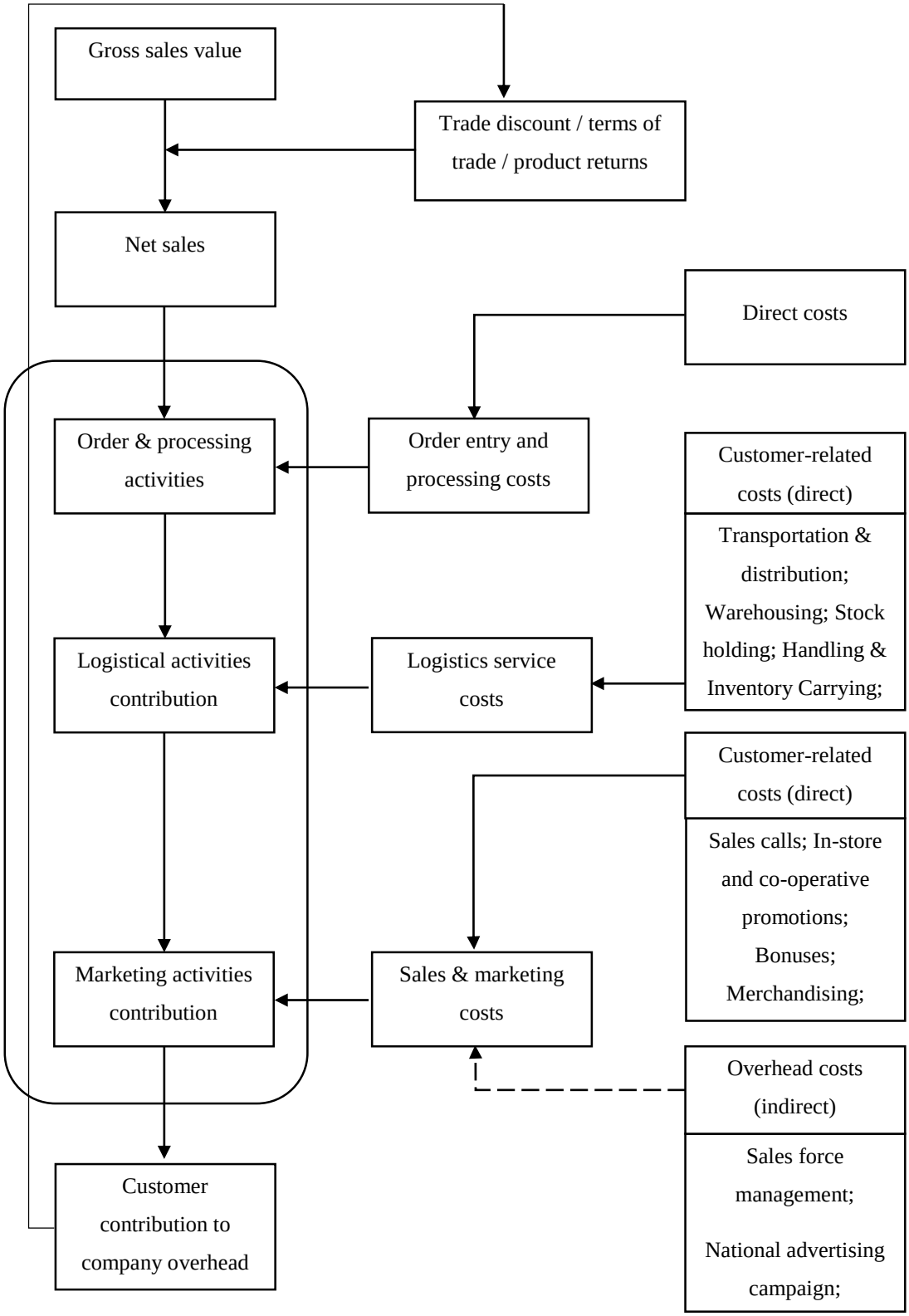

Figure 13: Cost allocation process diagram (adapted from Christopher, 2011).

4.1. Cost determination process

As indicated before, there is a growing dissatisfaction with TCAS, particularly when it concerns to the management of supply chain activities because they do not help in the identification of SCCs. Today, companies still rely upon arbitrary methods for the allocation of shared and indirect costs and hence frequently distort the true profitability of both products and customers (Christopher, 2011). Consequently, these traditional accounting methods are not well suited for analyzing the profitability of customers and markets since they were originally designed for the measurement of product costs. Hence, there is a growing necessity in operating cost reduction through logistics and supply chain management by correctly measuring the costs incurred in the supply chain. Harrison and Hoek (2008) explain that a very popular way of analyzing costs lies in considering the effect of the volume that activities engage on them. Costs tend to respond differently as the volume changes:

- Fixed costs tend to stay the same as volume of activity changes, or at least within a given volume range.
- Variable costs change as the volume of activity changes.

According to the authors, fixed costs include things such as the rental for warehouses, which is usually charged on a time basis. As the volume of a specific activity increases, it may be necessary to add additional warehouses, which will invariable result in increased fixed costs. Reversely, as volume decreases a warehouse would have also to be closed. In this regard, fixed costs represent business expenses that are not dependent on the level of goods or services produced by business. Fixed costs tend to be related to time, such as salaries or rents which are commonly paid every month, and are often referred to as overhead costs (Harrison & Hoek, 2008). Furthermore, variable costs include things such as direct materials, which are ordered according to amount demand, changing in proportion to the activity of a business. In this regard, if demand increases, the consumption of materials will also increase, and thereby costs will increase. Together, fixed costs and variable costs make up the two components of TSCC. Nevertheless, according to Harrison and Hoek (2008), by adding variable costs to fixed costs against a given range of volume (where fixed costs remain completely fixed), and add in the sales revenue (which also increases in line with volume), the breakeven point can be reached. Losses are present below the breakeven point and profits

are achieved above it. The authors explains that a helpful concept in evaluating break-even charts is the amount of contribution margin. For Hirsch (2000), an analysis of the contribution margin allows managers to better control revenues and costs, and helps on separating controllable from uncontrollable costs and revenues, providing them with a clear perspective of all costs. The manufacturing contribution margin is followed by separable manufacturing fixed costs (raw-material, packing, material and other variable costs) and a total manufacturing contribution (similar to gross profit). Furthermore, selling and administrative costs are deducted to yield a marketing contribution and hence, common corporate costs are allocated to get to profit (loss). Contribution margin is critical in decision-making, especially when it concerns to CP analysis. According to Harrison and Hoek (2008), another way to analyze the total cost concept regards to how costs can or cannot be directly allocated to a given product or service. Hence, two further categories emerge:

- Direct costs can be tied to specific products/services. The most obvious examples are direct labor and direct materials.
- Indirect costs are whatever is left over after direct costs have been allocated.

Indirect costs include everything from managing director's salary to the rent rates paid for the distribution center, basically anything that cannot be allocated directly to a given product. On the other hand, directness of costs is concerned with the extent to which costs can be allocated directly to given products. According to Lambert (2008), the development of CP reports must answer whether the origin of cost is dependent on unit volume or not, as Figure 16 indicates. If a variable cost is dependent, a charge must be applied over a customer or customer segment. If no, as a fixed cost, one must ascertain if the resource used is a consequence of satisfying a specific customer requirement, and so on. Assuming that cost is dependent on unit volume, it is appropriate to charge the customer or customer segment and if cost is not dependent, then it is necessary to determine if the cost is dedicated to a specific customer segment. Customers generate a net margin associated to their segment that covers in general these costs, providing the desired earning per share. The amount of net segment margin is responsible for determining the relative contribution of each customer (customer group) from the standpoint of financial performance.

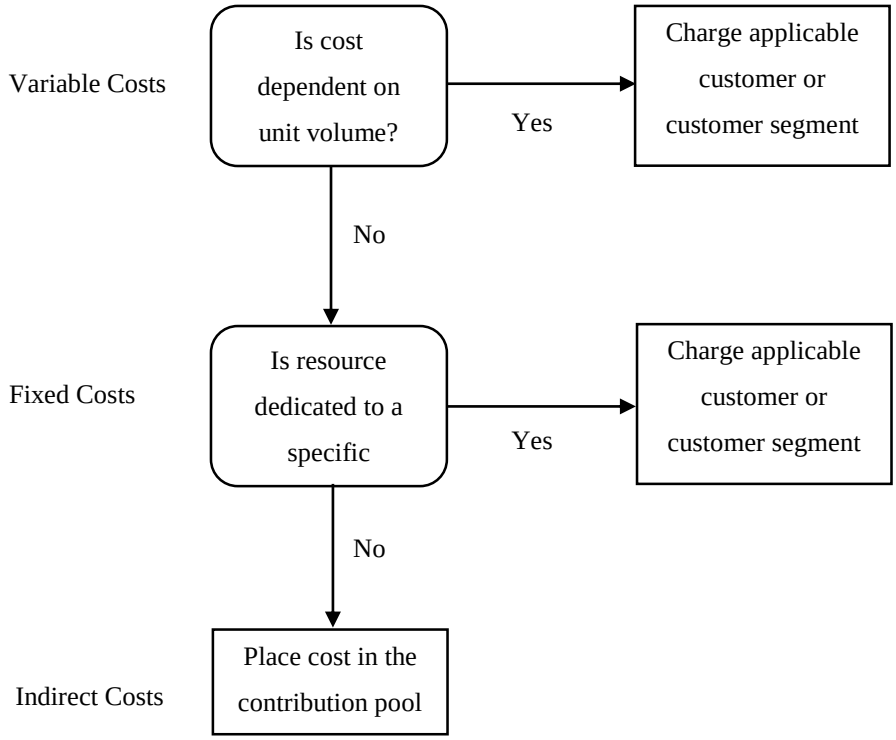

Figure 14: Assigning Costs to Customers and Customer Segments (Lambert, 2008).

The purpose to analyze costs in different perspectives is to gain better information regarding the nature of cost and where they incur to better manage overall businesses. Furthermore, this genre of information alongside with growth forecasting for each segment, enables management to develop strategies that will maximize profitability. Nevertheless, for the author a correct analysis to the profitability of products, customers and segments, should be done by deducting the avoidable costs (variable costs and non-variable costs directly identified to the object of analysis) from net sales. In this regard, Lambert (2008) proposes that CP reports should be presented in three levels of analysis:

1. Manufacturing contribution (net sales less variable manufacturing costs);
2. Contribution margin (manufacturing contribution less variable marketing and logistics costs); and
3. Segment controllable margin (contribution margin less assignable non-variable costs).

Note that manufacturing contribution does not necessarily have to do with the manufacturing function. The meaning is to identify the contribution that can be earned by performing a specific function, such as manufacturing, service distribution, etc. Most accounting systems tend to allocate fixed costs to individual segments, which eventually result in incorrect information because costs which are common to multiple segments are allocated based on arbitrary measures of activity. As a consequence, important information regarding cost knowledge will be lost due to the application of tools which are incapable of measuring costs correctly.

4.2. CTS activities and cost drivers

Freeman et al. (2000) defines the CTS method as an analytical approach that quantifies all activities and costs incurred to fulfill customer demand for a product through the end-to-end supply chain. It allows companies to monitor their costs and, therefore, manage their pricing strategy according to CP levels. According to Braithwaite and Samakh (1998) the CTS method is not considered a rigid documented procedure and should be applied at varying levels of sophistication from simple spreadsheets to advanced relational databases. However, the data to be collected should be as accurate as possible, and preferably with the aid of specific managers since they are the ones who better know the characteristics of the data in question.

The analytical models of the CTS approach are built in order to reflect the particular characteristics of the company in terms of both the complexity of the business and the issues that need to be addressed. As mentioned before, the variables to be included in these models are usually the product families, major customers or channels, and the activities necessary to perform the business. Furthermore, an understanding of the costs and drivers is necessary by collecting data in some detail and carry out analysis to understand quantitatively the major supply chain characteristics. Braithwaite and Samakh (1998) explain that this type of analysis usually include: total flows of products by product group/channel down the supply chain; the logistical variety of products within product groups/channels; order and inventory profiles; seasonality/cyclicality; sourcing; delivery performance; warehousing performance; and, transportation performance. The CTS method combines channels with products to every activity group. The complexity of the model is related to the number of channel-product

group combinations, and it is crucial to design the model at the right level of detail. The higher the combinations of channels with products the higher the complexity. However, models are easier to interpret if product groups and channels are kept sufficiently simple in a strategic viewpoint.

According to Braithwaite and Samakh (1998), detailed models do not necessarily have to provide more sophisticated conclusions. In some extent, it would be wise to develop models with detail, not forgetting the variables to be measured in order to avoid unnecessary misconceptions. An example of typical areas of data enquiry that may need to be accessed with the CTS method is shown in Table 5. The information represented in it draws the first analysis to take in order to identify which are the major activities and what are the main cost drivers of the business. Once the data is determined, one can analyze the key cost driving criteria through a relational database, and then re-compile it at the summary level into a spreadsheet. Note that the information in Table 5 is only an example of how data enquiry for a CTS analysis could be. The phase when costs have to be linked to activities using specific cost drivers is quite important and should be based on the main function performed in it. For example, in a warehouse, the main activity is basically called warehousing, and the driving cost of this activity is related to the main function performed, which can be considered handling unit and pick detail.

The cost driver will eventually define the final cost to be incurred when every process associated to the activity is done. Thus, Table 6 provides an example of a set of activities and drivers that can be present in any business. Later on, a more detailed list of activities and cost drivers are also analyzed in order to better understand the relationships between activities and what drives costs.

Table 5: Typical areas of data enquiry for CTS analysis (Braithwaite & Samakh, 1998).

Typical Areas of Data Enquiry for Cost-to-Serve Analysis	
Area of data	**Comments**
Product master file	Including product groups, standard manufacturing costs and physical characteristics (units/pallet, units/case, kg/unit, units/m3…)
Customer master file	Including customer reference, customer group and geography
Suppliers and manufacturing master file	Including geography and lead-time by product
Hub master file	Including geography and list of products held/cross-docked in each hub (hubs can be located at manufacturing sites)
Sales data at transaction level (typically for a period of 3 – 6 months)	Including order number, shipment number, product code, quantity ordered and delivered, hub reference, customer reference
Sales data, aggregated weekly for a period of 1 year	To understand seasonality and capacity requirements for hubs and outbound freight
Inbound data at transaction level (typically for a period of 3 – 6 months)	Including order number, product code, quantity, supplier/manufacturing reference, hub reference
Sales data, aggregated weekly for a period of 1 year	To understand seasonality and capacity requirements for inbound freight and hubs
Inventory data (for a representative date)	Including product code, number of units in stock, hub reference
Operating costs, including Head Office (derived from general Ledger)	
Fixed costs	Including rent, rates (e.g. electricity, gas, local taxes, maintenance, water…), indirect salaries fully loaded (including NIS, pensions, company cars), overheads for each facility (e.g. post, telephone)
Financial costs	Including building depreciation, computer depreciation, capital cost of holding the inventory, product obsolescence
Variable costs	Including direct salaries fully loaded, equipment running costs and depreciation
Distribution costs (derived from General Ledger)	
Fixed costs	Including indirect salaries fully loaded and overheads for each facility
Financial costs	Including truck depreciation
Variable costs	Including drivers' salaries fully loaded, fuel
Outsourcing costs (derived from contractual agreement with 3rd party)	
Warehousing rates	Including RH&D, cost/pallet/week, administration
Transportation rates	Including cost/pallet/week
Capacity constraints	Maximum capacity for manufacturing/warehousing/distribution

According to Weil and Maher (2005), assessing the relation between costs and activities involves two key issues related to the identification of cost drivers, and estimation of cost behavior. Cost behavior is usually dependent on the number of times an activity is performed. The authors inform there might be cases when a single cost driver is not enough to estimate costs. Some companies need to use multiple cost drivers due to the complexity of businesses. However, it is much simpler to associate every cost driver to an activity or, if necessary, to sub-activities. These sub-activities are part of an activity center, representing a major activity function, such as logistics & distribution, or order administration, etc. Note that once activities are defined, the total cost for each activity is calculated by using appropriate cost drivers which are multiplied by the amount of the drivers consumed by each activity. An activity cost driver is a specific factor that directly explains the cost incurred by the activity.

Table 6: Typical Cost Drivers by Activity (Braithwaite & Samakh, 1998).

Typical Cost Drivers by Activity	
Activity	**Cost drivers**
Order management and administration	Orders or order lines
Primary transportation	Curve, routing and frequency
Warehousing	Handling unit and pick detail
Inventory financing costs	Stock cover and IRR
Obsolesce	Stock cover and product life cycle
Direct delivery	Cube and frequency
Local delivery	Drop density and order size

Initially, Christopher (2011) states the method requires that activity centers are capable of identifying the corresponding sub-activities, such as transport, warehousing, inventory, etc. In this regard, Table 7 provides a simple idea of how major activities are composed by several minor or sub-activities. This approach can turn to be particularly powerful when combined with a CP analysis for customers, market segments or distribution channels. Mostly because even customers with low margins may still be profitable in incremental costs terms if not on an average cost basis. Therefore, a company would be worse off if those low

margin customers were abandoned, not to mention the importance of the corresponding market-share associated with them. The idea lies in working with these particular customers to reverse unwanted situations and thus drive up contribution margins to attain higher levels of profitability.

Table 7: Typical activities and sub-activities (adapted from Freeman et al., 2000).

Typical Activities and Sub-activities	
Sales & Marketing	Commissions Channel overhead
Order Administration	Order Processing Order Changes Credit Check Price Confirmations Claims & Debits/Credits Other Order Admin
Logistics & Distribution	Replenishment & AP Receive & Put-away Storage Picking & Checking Special packaging Invoicing & Collection Transportation

Currently, the state of technology in most organizations still assumes a linear relation between costs and cost drivers. The simplest cost behavior pattern separates costs into fixed and variable components. Total variable costs change proportionately with changes in total activity levels (Weil & Maher, 2005). Assuming one cost driver for a given activity, costs can be simply divided into fixed and variable components, and costs tend to increase linearly

with the cost driver. Hence, a simple equation can be defined, where total cost equals to fixed costs plus variable costs per unit for the cost driver. Weil and Maher (2005) add that the costs associated with the relation include direct costs of the relationship, such as freight costs; activity costs, such as loading; post-sale activities; and carrying costs associated with inventory and receivables. Amit et al. (2005) add that channel partners in a supply chain incur several distinct costs, which can be divided into five elements: inventory holding costs; materials handling costs; transportation costs; order processing costs; and packaging costs. These costs were identified as a result of discussions with traders, practitioners and supply chain experts. The authors inform that there can be variations among channel members in terms of costs composition. Furthermore, if the current status quo of a company's business models suffer any kind of change, it might be necessary that the model requires some redesign to accommodate projected future costs and capacity. The model should be flexible enough to be updated at any time so it can keep up with a company's business progress. The authors add that an important aspect of the CTS method lies in the capability of tying back the results to the total cost by function in the business. This will ensure that fixed variable ratios are constantly well interpreted, and the model is capturing and linking the various cost drivers correctly. To sum up, the final insight of the analysis regards to relative costs of the product families and the rate at which the planned margin is eroded by channel. Supply chains are known for hosting huge differences in cost, which implies that companies should be prepared to mitigate these costs by developing strategies that focus on investment, marketing, sourcing and commercial decisions based on having a CTS framework to hand (Braithwaite & Samakh, 1998). For Weil and Maher (2005), customers are responsible for providing revenues, and the practice of partitioning profit among customer or channel participants, or both, provides insights regarding the following factors:

- The value provided by the firm to customers.
- The maximizing sales effort for different customer/channels.
- The drivers of underlying customer/channel costs.
- The success or failure of customer strategies.
- The pricing of various channel configurations.
- The costs of horizontally linked functions.

Relation profitability analysis combines logistics, marketing, and sales-related activities into a complete picture of the cost to serve the customer. The CTS method identifies the costs

that are generated as a result of specific logistics & customer service strategies aimed at targeted market segments. According to Christopher (2011), the aim lies in establishing a better matching of the service needs of the various markets that a company competes in with the inevitably limited resources of the company. In this regard, the author presents four stages in the implementation of an effective costing system process:

1. Define the customer service segment: Use an adequate methodology to identify the different service needs of different customer types. The basic principle assumes that not all customers share the same service requirements and characteristics they should be treated differently.
2. Identify the elements that produce variations in the cost of service: This step involves the determination of the service elements that will directly or indirectly impact upon the costs of service, e.g. the product mix, the delivery characteristics such as drop size and frequency or incidence of direct deliveries, merchandising support, special packs and so on.
3. Identify the specific activities used to support customer segments that generate costs and the specific cost drivers involved. These may be the number of lines on an order, the people involved, the inventory support or the delivery frequency.
4. Attribute the costs present in every activity by customer type or segment. It must be emphasized that this is not cost allocation but cost attribution. In other words it is because customers use resources that the appropriate share of cost is attributed to them.

In this regard, the CTS method allows a collection of the costs as they are incurred by customers from the point of order generation through to final delivery, invoicing and collection. The basic intent of, e.g. logistics cost, is to provide managers with reliable information that will enable a better allocation of resources to be achieved. Christopher (2011) adds that the purpose of logistics and SCM is ultimately concerned in meeting customer service requirements in the most cost effective way, and for that reason, it is essential that managers have the most accurate and meaningful data possible.

One must understand that improved cost knowledge may provide the means to address such challenges and to improve overall relationships. Suppliers must become totally aware about the internal costs of their operations as well as the costs incurred to serve their customers. According to Norek and Pohlen (2001), the lack of cost knowledge continues to exist despite

the emphasis on SCM and the potential for increased competitive advantage. Ross et al. (2007) state that the CTS method provides the organization with the necessary insights into process costing, performance and the profitability of various products, services and customers. They also add that information sharing should be transparent when adopting supply chain strategies between supply chain members. It is very easy to recognize from the literature that still many manufacturers and retailers continue to rely upon traditional financial systems to support key decisions. The information provided by these measures do not necessarily mean it is useless. The problem is that it does not provide the information needed about the efficiency of supply chain structures and it does not help on the identification of opportunities to simultaneously reduce costs and increase performance.

4.3. Activity determination process

Before starting an analysis to the costs incurred when serving the customer, it is required that every activity is correctly identified. This chapter illustrates a framework of how activities can be identified according to specific elements that are actually part of each activity. The criteria for choosing such activities regard to the identification of those major activities necessary to operate in the supply chain structure. These activities belong to the supply chain structure and make it possible for customers to have the desired product and service needs. Identifying the activities present in any business nature is the first step among several other steps to implement the CTS method, and this framework allows this procedure to be possible. In this regard, the following tables provide several supply chain activity groups and characterizes each of them in order to identify the respective cost drivers. A simple definition is also given for each activity. As mentioned before, a cost driver is a frequency measurement that seeks to identify the intensity or the number of times that an activity is required, and consequently measure the costs associated with it. Cost drivers have to be well defined taking into account the cost-benefit relationship that an activity produces. Once activities are categorized, they have to be associated with a cost category for further allocation of the costs.

The customer specific activities that are considered for this framework include order activities, processing activities, logistic/distribution/warehousing activities, sales & promotions activities and marketing activities. Note that the proposed activities are only an

example of the required activities to answer customer needs. Partners in a supply chains may have different needs, and consequently, different activity groups depending on the nature of the business and type of customers being served. Hence, the following Table 8 provides the first approach to the order activity group, where the activities, cost drivers and cost category belonging to this group are identified.

Table 8: Order activities group determination (adapted from Freeman et al., 2000).

Supply Chain Activities				
Activity Group	**Activity**	**Definition**	**Cost Driver**	**Cost Category**
Order Activities	Order Processing	Receiving and processing an order by a Customer Service Representative	Number of order lines per EDI and non-EDI transaction	Customer
	Order Changes	Correcting or changing an order after the order has been entered	Number of order changes	Customer
	Tenders and Quotes	Processing price quotations for tenders by Commercial Management	Number of quotations	Customer
	Credit Checks	Approving, changing and researching credit status of customers	Number of credit holds	Customer

For the order activity group, the corresponding activities that are performed are order processing, order changes, tenders and quotes and credit checks. These activities make it possible for suppliers to receive customer orders and proceed with answering customer demand. These group of activities alongside with processing activities is particularly concerned with how customer relationships are managed. In this regard, every cost category associated with this group is mainly customer-related and the cost drivers are driven by the number of customer orders, e.g. number of quotations performed per customer. Consequently, a customer who requires more quotations will naturally represent higher expenses for the supplier since the cost driver is related to the number of quotations per client.

According to Freeman et al. (2000), the average cost per activity is calculated by multiplying the effort required by a loaded cost per employee minute, including all costs associated with the customer service department including salaries, benefits, and administrative operating costs. For activities which include effort outside the customer service department, for example 'tenders and quotes' and 'credit checks', the loaded cost per employee per minute in the other departments, multiplied by their effort required, is added to the customer service loaded cost per minute. The next Table 9 complements the order activities with the processing activities. The activities present in this group are the next step once the order activities are done. At some extent order activities can be grouped with processing activities but for a better comprehension they are shown separately.

Table 9: Processing activities group determination (adapted from Freeman et al., 2000).

Supply Chain Activities				
Activity Group	**Activity**	**Definition**	**Cost Driver**	**Cost Category**
Processing Activities	Price Confirmations	Processing price confirmations requested by Commercial Management	Number of price confirmations	Customer
	Order Return Processing	Receiving and processing orders for return product	Number of return authorizations	Customer
	Processing Claims	Resolving customer deductions and claims from invoices	Number of adjustments	Customer

From Table 9 it is clear that processing activities are a consequence of an issued order by the customer. Therefore, the activities present in this activity group are price confirmations, order return processing and processing claims. These activities are also customer-related belonging to the customer cost category. Cost drivers represent the number of repetitions of each activity. Moreover, the following Table 10 illustrates the logistic, distribution and warehousing activity group. This activity group tend to be more complex than other activity groups because, as explained in previous chapters, the management of logistic activities constitute a major portion of the overall supply chain activities.

Table 10: Logistic activities group determination (adapted from Freeman et al., 2000).

Supply Chain Activities				
Activity Group	**Activity**	**Definition**	**Cost Driver**	**Cost Category**
Logistic / Distribution / Warehousing Activities	Replenishment and Supplier Payment	Include inventory requirements planning and replenishment, including the processing of supplier invoices	Purchase order lines	Channel
	Distribution Center: Receive & Put Away	Receiving product, moving product from receiving point to storage and opening new locations	Purchase order lines	Channel
	Distribution Center: Picking	Group the types of orders to be picked into *N* categories in order to effectively capture the variability amongst the customers as it pertains to the picking & checking of orders An example of categories are: 1) Normal order; 2) Normal order with special container; 3) Distributor order; 4) Spare parts order	Picking activities include picking goods, checking order, moving goods to loading area, goods wrapping and loading trailer. Thus, to capture the level of detail necessary, a list of actions is prepared for each type of order to be picked	Channel
	Storage	Separated into 2 categories: Standard Storage where inventory is not dedicated to specific customers, but rather to channels, and Dedicated Storage where inventory is dedicated to a specific customer	For the standard storage the cost driver is storage cost per palette foot print by channel. For the dedicated storage is storage cost per foot print by channel	Goods
	Special Packing	Include any sorting, labeling, and repackaging to customer specific requirements	Time spent by product and customer characteristics	Goods
	Invoicing and Collection	Include the receiving, recording and processing customer payments	Number of invoices by customer	Customer
	Transportation	Include the physical movement of goods from the distribution center to the customer	Actual costs incurred by freight carrier, by customer as established by a freight auditing service	Customer

It is expected that the costs arising from this group of activities represent a bigger part of the total costs incurred when serving customers. In this specific case, the framework provides seven main different activities for this activity group. However, it is expected that in real business case situations there may be plenty more activities depending on the services being provided by the supplier. As it can be analyzed from Table 10, the activities present in this group are replenishment and supplier payment, distribution center – receive & put away, distribution center – picking, storage, special packing, invoicing and collection, and to finalize transportation. The first three activities present a channel cost category because they are mainly driven by purchase orders to suppliers and actions in distribution centers. On the other hand, the cost category for the storage and special packing activities is related to the nature of the goods or products. Usually these goods are constituted by product families, where each family can have up to several products. A company that supplies several different product has to deal with different ways of storing and packing products. Some products require special environments and have to be dealt with extra caution, other products may have to be handed carefully due to their fragility, others have to be moved faster due to demand instability, etc. It is important that these activities are assessed in great detail to identify all properties that drive costs. The last two activities, invoicing, collection, and transportation represent the last processes of the logistics activity group. In this case, the associated cost categories are customers since these activities answer directly customer specific needs. For example, transportation activities include the physical movement of goods from the distribution center to the customer. Note that to each activity there are specific metrics to identify and calculate incurred costs. These vary from activity to activity and concerns to the nature of businesses.

Next Table 11 represents the sales & promotions activity group. Activities in this group regard specifically to customers because they represent the moment when customers manifest their satisfaction in relation to the state of how products are provided to proceed with further payments. The activities present are display allowance, listing fees, claims and returns.

Table 11: Sales & promotions activities group determination (adapted from Freeman et al., 2000).

Supply Chain Activities				
Activity Group	**Activity**	**Definition**	**Cost Driver**	**Cost Category**
Sales & Promotions Activities	Display Allowance	These stands or racks are designed to present the manufacturer's products in an optimal way, and to boost sales often through impulse buys	Capture and allocate all costs incurred in the development of the stands	Overhead cost per display
	Listing Fees	Usually large customers, particularly in the grocery industry, require manufacturers to pay a listing fee for each SKU that is put on the retailer's shelves	Expenses and risks for the retailer to stock new products	Customer
	Claims	Refers to either warranted or unwarranted claims made by customers. Different customer behaviors are reflected in this account	Retailers taking deductions for discounts that have not been and reflect them in their payment of invoices	Customer
	Returns	Most organizations have a returns policy designed to add a certain level of guarantee to the products being shipped. It is important to look at the patterns and amounts of returns for each major customer	Products shipped back, the most common form of returns is for damaged or expired goods	Customer

The first activity, display allowance, is related to those stands or racks which are designed to present the manufacturer's products in an optimal way or any other way desired by retailers. Hence, the cost category is dependent on the overhead cost per display since the intention is to capture and allocate all costs incurred in the development of the stands. The other three activities present a customer cost category because they reflect the level of satisfaction obtained from individual customers. The following Table 12 regards to the marketing activity group and its associated activities.

Table 12: Marketing activities group determination (adapted from Freeman et al., 2000).

Supply Chain Activities				
Activity Group	**Activity**	**Definition**	**Cost Driver**	**Cost Category**
Marketing Activities	Trade spending and discounts	The large number of spending options is required to achieve different objectives with customers. Terms of sale also offer flexibility around price to some extent, but are primarily intended to modify the customer's ordering and payment behavior	Customer preferences and demands when trading and/or negotiating prices	Customer
	Merchandising	Special pre-packs or other programs such as manufacturer's coupons requiring the participation or assistance of the retailer	Cash given to customers in return for in-store merchandising performance	Customer
	Coop Advertising	The money is usually in proportion to the number and prominence of the supplier's product(s) in the advertising initiative. Type, frequency and reach of advertising initiatives for customers	Cost to participate in customer advertising initiatives	Customer
	Performance spending	This activity can take the form of things such as preferred and/or increased in-store positioning, special display locations, end-isles, etc.	Payment to the customer in return for specified activity around particular items or brands	Overhead cost per display

The activities are trade spending, discounts, merchandising, coop advertising, and performance spending. The marketing activities are once again related to the customer cost category and only the last activity, performance spending, presents a cost category based on overhead cost per display. The reason is that performance spending happens when there is a payment to the customer in return for specified activity around particular items or brands. The assessment of marketing costs provide relevant quantitative data that assist marketing

managers in making decisions regarding profitability, pricing, and adding or dropping the product lines or territory (Drew et al., 2004).

Identifying activity groups and corresponding activities with the associated cost drivers is a very meticulous process. This step requires absolute certainty that all activities are correctly identified. The data should be acquired with local managers who have a better understanding of the processes. The CTS method requires that all activities have a clear relationship with customer-related costs in order to combine them with the objects of cost, which are the distribution channels, customers, and products. A possible next step for the framework lies in identifying the relationships between distribution channels and product lines. Assuming that for a given line of business the products being distributed belong to the family of dairy food. It would be interesting to realize the implications that these products could post to all activities mentioned before, e.g. transportation and storage conditions, alongside with the cost differences that would arise from customer to customer. The values belonging to every product per activity for every distribution channel should be acquired with specific managers. These managers are often responsible for managing these activities and other accounting functions in order to have access to detailed information on the matter. Once the costs incurred are identified one can calculate the overall CTS values through the use of simple processes. After the calculations are done, an analysis of the results can be made in order to identify any gap or unrealistic values to further proceed with the calculations.

Obviously some restrictions may arise during the process of measuring the costs incurred to serve the customers. Any unforeseen or impossibility of measuring any costing aspect during the CTS measurement process should be analyzed carefully in order to determine the most suited solution. The analysis at the data should be based on several specific criteria, from which it is possible to acknowledge the true cost values incurred when serving the customers. The way data is collected represents a major step of the CTS method since it is with the collected data that one can correctly model various cost elements that can be later used to develop optimization strategies. These cost elements can be incorporated into an objective function of a mathematical programming model with the objective of minimizing total cost components that are identified at this stage of the CTS measurement.

4.4. Customer analysis process

Nowadays is quite clear that profitable businesses have higher chances to succeed and to achieve high levels of competitive advantage, and those who are not profitable, do not even stand a chance with current competition. Clearly, companies are driving their efforts to boost sales, cut costs, and increase market share, but that is not possible with the lack of profit. Several organizations are aware they have unprofitable customers, SKUs, product lines, and channels, but they cannot easily identify which ones are sabotaging their bottom line (Acorn, 2013). However, as indicated previously, the CTS method helps identifying which customers and products matter most and how to manage them with the proper cost/service balance. An example is provided by Mulhern (1999), who states that as marketing activities target customers more precisely through direct and interactive forms of communication, the information arising from a CP analysis plays a central role in the development of marketing strategies. The measurement of CP may seem like a simple process to perform but it is rather complex. The exact specification of a profitability analysis has important implications for, e.g. logistics and marketing decisions, based on profitability measures. A consideration of several specific issues that pertain to profitability analysis should to be considered in the context of a strategic situation, which might vary for different applications.

Moreover, the CTS analysis provides an activity driven view of how specific variables, such as products, customers, and channels, consume resources and incur costs. With this complete insight, those responsible for bottom-line performance can make critical and well informed strategic decisions while quickly identifying the underlying causes of poor profitability levels (Acorn, 2013). Basically it allows the possibility to drill down from summary results to the transaction level and calculate the profitability of each customer account, based on the actual business activities and overhead costs incurred to service that customer. In this regard, the CTS method, as being a new enterprise-wide performance measurement system solution, allows managers to access detailed financial information, including analysis on the cost of different activities and the profitability of individual customer accounts. Which supports managers on decision-making situations and by enabling a wide range of proactive cost reduction and profitability improvement initiatives (Acorn, 2013).

According to Krakhmal (2008), the examination of CP values require that relevant members of management or representatives from the various departments within a business are

involved in analyzing the results. Management have the possibility to visualize into net profitability for customers, channels, segments, products and shared services. A very useful way to interpret the output acquired after the CTS analysis lies in the application of the Pareto Law or the 80/20 rule on the basis of margin after CTS. As indicated in chapter 2, the application of the 80/20 rule to segment a company's profits provide managers the possibility to identify which customers are the 'Platinum' and which ones are the 'Lead'. However, performing the 80/20 analysis on sales revenue shows a typical Pareto curve as the sales values are usually positive, but there could be exceptions where net sales values may be negative by error or if discounts/deductions are greater than the gross sales value for a certain period of time (Deshpande, 2012). Moreover, when this analysis is performed on profitability data, it can show negative values for unprofitable accounts, which eventually results in the so called 'whale curve', as illustrated in Figure 15.

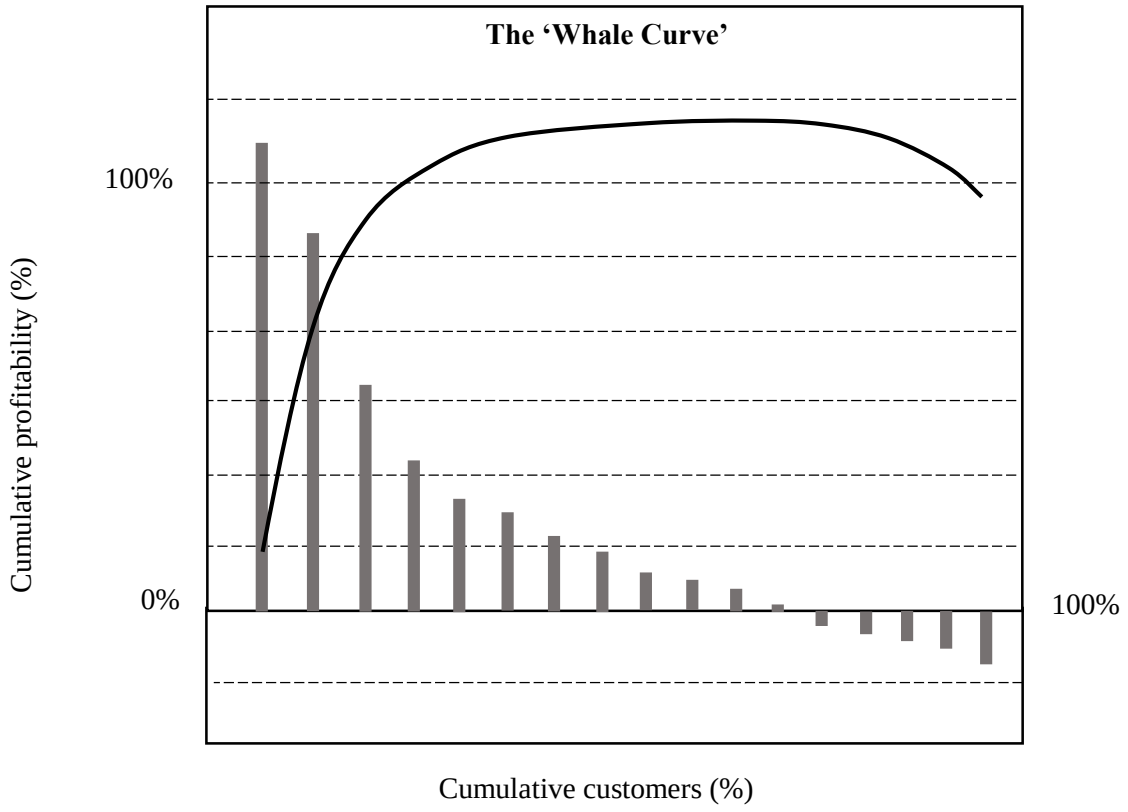

Figure 15: Example of a 'whale curve' (adapted from Deshpande, 2012).

The output from the CTS analysis for CP purposes as shown in Figure 15 can be obtained by plotting the cumulative profitability versus the cumulative percentage customers corresponding to the cumulative profitability (Cooper & Kaplan, 1991). As indicated in chapter 2, it is common to obtain the results within a range where 80 per cent of the profits of a business come from 20 per cent of the customers, while the remaining 20 per cent of the profits originate from 80 per cent of the customers. Hence, the largest customer groups usually represent the most unprofitable accounts, which is consistent with Kaplan and Cooper (1998) findings that a company cannot lose large amounts of money with small customers. The authors also state that only a large customer, working in a particularly perverse way can be a large loss customer. Again, the left side of Figure 15 presents the cumulative percentage of customers that have high values of profitability and low CTS values. As the amount of profitability decreases by customer and the CTS increases, the cumulative profitability curve tend to flatten up to a point where it reaches its maximum. At this point, customers start to provide negative values of profitability and the curve turns downwards (right side), turning into a 'whale shaped curve'.

According to Krakhmal (2008), the manner in which the CP analysis it is configured enables management to simulate the impact of decisions, such as price adjustments and resource allocation decisions, on the potential profit contribution of a business customer base, and thereby strengthening the decision-making process. This rationale is usually applied for product costing in multiproduct setting stems from a need to determine which products are most profitable and which, therefore, should be most extensively promoted. On the same manner, CP analysis can be used to gain insights into which customer segments provide the largest contribution to a business profit and which customer segments should be targeted for promotion (Krakhmal, 2008). Clearly, CP analysis can be used to inform management deliberations on how the marketing budget should be allocated across a given business targeted customer segments. For Mulhern (1999), profitability measures can help organizations target marketing efforts to the most lucrative market segments. At the simplest level, two segments may be formed - customers worth keeping (retention segment), and those that are not worth the effort.

A CP analysis is very helpful to support decision-making for commercial activity management, to review commercial policy, and to renegotiate with loss-making customers. Once the CTS is measured, a second step lies in the development of optimization models to

increase the performance of business activities across the supply chain. An alternative regards in restructuring current activities to serve the customer, with the objective of obtaining at least the same results at lower costs. However, the aim is always to improve customer service in order to increase customer value by reducing the costs incurred to serve.

Nonetheless, loss-making customers require further specific and in-depth study such as specific detailed plans to acquire the reasons of their unprofitability. Some of the strategies are related with forecasting and inventory information sharing and automation of order processing, among other strategies. Note that these customers do not necessarily are a burden to the company, they do not have to be eliminated at all cost. The interesting part lies in turning them profitable, even because at some point clients with a small margin after CTS are the ones accounting for the largest market-share of the company. In this context, it is worth mentioning that most service-activity costs are fixed costs and eliminating loss-making customers thus eliminates the amount of the contribution that these customers account for, which in some cases it does not even eliminate the corresponding fixed cost.

As for the customers generating profits and with a high margin, it would be wise to develop incentive plans to maintain and develop better relationships. These customers are the reason why the company exists, and services should be personalized according to the levels of profitability generated. Customers with high levels of profitability should be provided with high customer service. On the other hand, companies with a lower margin of profitability should not be worth spending too many efforts with high levels of customer service. The results from the CTS application provide managers with the necessary information to develop a profitability-based customer-segmentation model, as indicated in chapter 2. Hence, customers have to be classified according to their profitability levels, making it easier to develop appropriate strategies to improve overall performance.

To summarize, by recognizing that different customers, products, service activities, and distribution channels each contribute with different margins, it is possible to identify the unprofitable and low-margin product and customer combinations, high-cost processes, and then develop action plans for each in order to improve overall business' profitability. With this information, one can develop optimization solutions in order to perform strategic decisions regarding which actions should be taken to improve the margins of unprofitable customers.

5. Conclusions and future work

The findings from this study show that a measurement of the costs incurred to serve customers, following a CTS approach, provide any organization with specific and realistic customer information that allows a comprehensive CP analysis, unlike most traditional accounting systems. The CTS method is a powerful tool that crosses all functional areas in the supply chain with the intention to measure TSCs and to accurately assess the total profitability of an individual product or item being sold to a customer. The application of the CTS methodology defines all activities necessary to render customer delivery and collect product revenue by capturing how each major supply chain activity affects the complete end-to-end costing of serving each customer. By other words, the CTS method has the purpose to determine the total cost of serving each individual customer at a SKU level according to the level of service that is previously established. Managers have to understand where costs occur in the supply chain when conducting a CTS project. The benefits of adopting this approach yields several opportunities to formulate appropriate strategies and restructure current activities to serve customers, aiming to attain the same or even better results at lower costs, by improving the overall supply chain performance and business profitability. Meanwhile, unprofitable and low-margin product and customer combinations demand the development of proper action plans to reverse the situation. Hence, differences among profitability levels when serving different channels alongside with the complexity of certain activities justify the use of this kind of information in making appropriate adjustments to policies and service levels.

This dissertation combines an analysis of several research papers and the empirical data present in this study provides a strong indication that the CTS methodology and CP analysis can be a powerful tool to supply chain managers. Alternative pricing strategies, reconfiguration of marketing and logistics processes, renegotiate terms with specific customers, among many other measures are some of the options that management can accomplish. By eliminating customers and/or products that are identified as unprofitable by the CTS measurement also drops the associated revenue, without guaranteeing that the associated fixed costs will be at all excluded. The CTS method should be used as a decision-making tool but it requires that changes are linked into the network model to ascertain the

modifications. The model should realize the impacts that may result from modifying the structure of overall business processes. Note that a CTS model can also enable an accurate prediction of the CTS of a future state. The configuration of CTS models is pretty much synonymous of developing optimization solutions. However, the development of optimization models require a clear transparency of information sharing in the total chain as a very important prerequisite for total SCM. Both operational and tactical processes have to be monitored to enable managers the ability to decide when and where necessary. The CTS method offers organizations with the necessary insight into process costs, performances and profitability of various products, services and customers and should be used periodically to re-assess the business operations.

If correctly adopted, the CTS methodology is profitable and pays off immediately, by allowing a more comprehensive CP analysis than traditional measures. However, some difficulties are present when undergoing information gathering and data extraction, which present great challenges for managers and should be acquired on-site with key representatives to avoid inaccurate measurements. The frequency and quality of data sharing among supply chain members is directly correlated with the success of SCM, especially in this competitive era where competitive advantage plays a major role. The notion of sharing information among supply chain partners is certainly an emerging trend in the supply chain culture without regard to industry type. Furthermore, the differences in cost among customers are a result of several major factors, with an emphasis on customer revenue, differences in customer service levels, differences in distribution channels, and differences in service cost (Foster, Gupta, & Sjoblom, 1996). The main benefit of a CTS analysis in this study lies in how this kind of information can be used to make appropriate adjustments to policies and service processes, especially when it concerns with loss-making customers and their respective share of contribution margin.

According to the findings from this research, many other opportunities for research arise. One of the challenges deals with the reconfiguration of logistics business processes based on the resulting CTS information and with the adjustment of marketing functions when identifying differences among CP levels. As mentioned before, future studies could address the impact of using this type of information on the design of processes and activities adopted by companies to satisfy customers demand. To create policies of sales force incentives, choices of distribution channels and strategies of relationship and collaboration with clients.

As indicated previously, another opportunity for research deals with those customers who present a negative margin after CTS, taking into consideration that by eliminating these customers the margin provided by them will also be eliminated, without necessarily reducing the fixed cost of the company. Furthermore, studies could also investigate the interaction between the CTS and the benefit of serving specific customers, not just by taking into account customer margins as predefined targets. These customers do not have to be solely related to the industrial sector, but also directed to other sectors of activity that have not been explored.

The CTS method is expected to provide an opportunity for applying decision-making rigor based on a proven method and grounded in field research. Globalization is driving many industries to develop their capabilities and competencies in order to be able to offer a multi-diverse customer service. In this case, logistics service providers must have a sound understanding of cost drivers for their services, and a flexible strategy to determine and monitor the CTS (Ross et al., 2007). Future research should also should address cost drivers and pricing in scenarios where 3PL providers offer more complex combinations of value-added services. The impact of segmentation at this stage could also be addressed to determine if optimization strategies follow specific patterns to facilitate decision-making.

Therefore, the benefits from applying the CTS methodology are considered relevant in the perspective of improving the supply chain performance. The results that can be obtained are a major step in developing the right strategies to improve overall business efficiency and thus driving up competitive advantage.

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